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**State of the High Technology
Sector in British Columbia:
Inaugural Benchmark Report
Wednesday, December 6, 2000**



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December 6, 2000

**Re: State of the High-Technology Sector in British Columbia:
Inaugural Benchmark Report**

In July 1999 the Province released the *BC High-Tech Strategy*, which identified key goals for the growth of this very important sector in our economy. The report also recognized the need for some method to continually measure our progress toward these goals, and that the first step would be a baseline comparison against other key jurisdictions. I am pleased to now announce the completion of the inaugural benchmark report of BC's high-tech industry.

Shortly after the Province's strategy was announced, the Science Council of BC established a Performance Measures Committee, the members of which would define the criteria to be measured and the jurisdictions we would compare against. This foundation work was completed last summer, and KPMG was engaged to collect data and assemble a report.

The completed report represents a tremendous collaboration of effort and commitment by industry, government and academia. I want to particularly thank the nine committee members and our Science Council staff, Uschi Koebberling and Veneranda Dettmers, for their contributions.

This inaugural benchmark report will be a powerful tool for developing strategies and allocating resources to realize BC's full potential as a leader in the high-tech industry. I am extremely proud of the role this organization has played in the initiative to date, and look forward to continuing our involvement as we move into the next stage of the process.

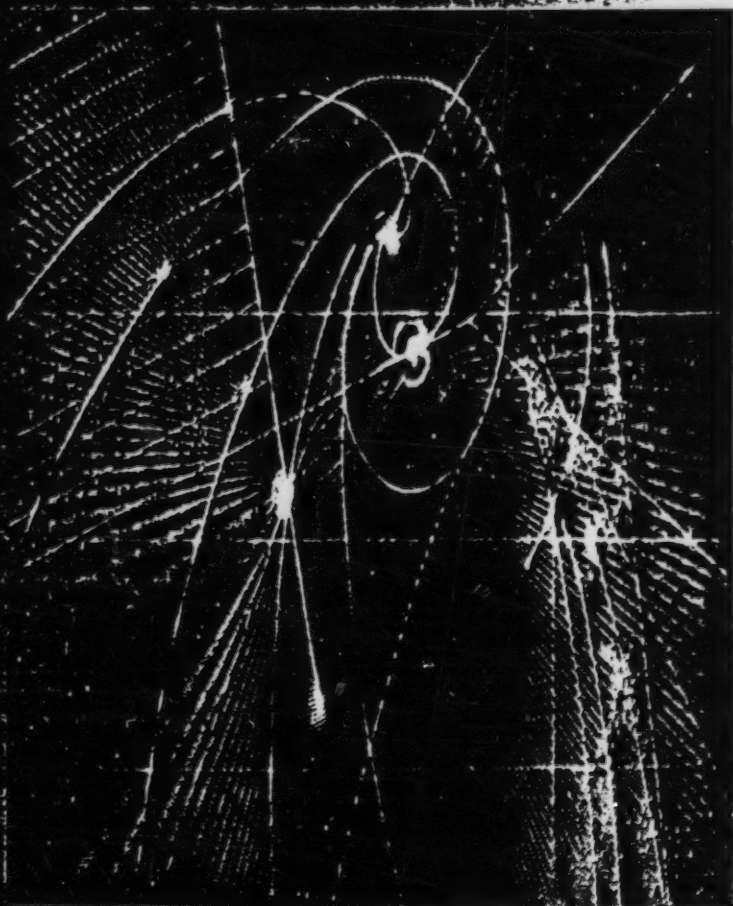
Sincerely,

J.K. Reichert Ph.D., P.Eng.
President

JKR/lq

STATE OF THE HIGH
TECHNOLOGY SECTOR
IN BRITISH COLUMBIA:

INAUGURAL
BENCHMARK REPORT



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Performance Measures Committee
Science Council of BC
Burnaby, B.C.

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Vancouver
December 4, 2000
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KPMG Consulting

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Executive Summary

High technology is one of the fastest growing industry sectors in both North America and British Columbia. In 1999, BC's high tech industry employed 52,000, up 10.1% from the previous year. Similarly, the gross domestic product (GDP) attributable to BC's high tech sector reached \$2.64 billion in 1998, up 6.2% from the previous year.

In 1999, the Province of British Columbia tasked the Science Council of BC to develop and implement performance measures for its High Technology Strategy¹. In response, the Science Council formed a Performance Measures Committee (PMC), composed of representatives from industry, academia, and government, to direct the project, and engaged KPMG to perform the study.

This study analyzes the current state of the BC high tech sector in terms of 39 indicators, including nine key "headline" indicators of general public interest. Headline indicators are discussed in the context of (1) the Province's four High Tech Strategy goals¹, and (2) the performance measures framework developed for this study. They describe trends in BC's high technology sector, and summarize current information on the high tech sector in BC and in six other jurisdictions² – Alberta, Ontario, Quebec, Washington State, Oregon, and Massachusetts.

A. Current State – Relative to BC High Tech Strategy

The current state of the BC high tech sector, in the context of the Province's four High Tech Strategy goals, is assessed as follows:

- **Goal #1 – Make BC a Place of Choice.** As illustrated in Exhibit ES-1, high tech GDP, employment, and wages show rising trends in BC in recent years, while tax rate trends have generally remained flat. On the other hand, the relative significance of BC's high tech industry tends to be lower than the other US and Canadian jurisdictions studied.
- **Goal #2 – Develop and Attract Talent.** BC's post-secondary education spending is above the Canadian average, although recent trends have been flat. Wages, primary/secondary education expenditures, and skills needs are at about the Canadian average, but are generally below US levels. BC's ability to develop and attract talent appears similar to other major provinces, but below the US jurisdictions examined.
- **Goal #3 - Expand Research and Development.** Recent trends in BC have been flat, and BC's statistics do not compare well with the other Canadian and US jurisdictions

¹ The BC High Tech Strategy outlines the goals, principles for action, and objectives for the BC high tech sector, and includes four key goals: (1) Make British Columbia the place of choice in high tech business; (2) Develop and attract outstanding talent; (3) Strengthen British Columbia's research and development capability; (4) Market and promote British Columbia.

² The information presented in this study is compiled from numerous sources, which reflect many different data-gathering methodologies. The reader is strongly advised to consult primary sources to assess the comparability of data, prior to drawing firm conclusions in any specific area.

examined. While R&D tax incentives were introduced in 1999 in British Columbia, the impact of these incentives would not yet be reflected in R&D statistics.

- **Goal # 4 – Market and Promote BC.** The linkages between the headline indicators examined and this goal tend to be indirect. However, for two of the detail indicators we have identified some data which provide some insight into BC's performance. Compared to benchmark provinces, BC is average in terms of Venture Capital and below average in terms of Foreign Direct Investment.

Exhibit ES-1

Achievement of BC High Tech Strategy Goals

Goals	BC Trends ^(a)	Comparison ^(b) to	
		Provinces	US States
No. 1: Make BC a Place of Choice			
• High Tech GDP (as a % of total GDP)	↑	Below average	n/a ^(c)
• Employment	↑	Below average	Below average
• Wages Earned ^(d)	↑	Average	Below average
• Tax rates:			
- Corporate	→	Less favourable	Less favourable
- Overall personal	→	Average	Less favourable
No. 2: Develop and attract talent			
• Spending on Education:			
- Primary/Secondary (per student)	↑	Average	Below average
- Post-secondary (per capita)	→	Above average	Average
• Science & engineering graduates (# per capita)	↑	Below average	Below average
• Wages Earned ^(d)	↑	Average	Below average
• Skills Needs	→	Average	n/a
No. 3: Expand research & development			
• R&D Expenditures (as a % of total GDP)	→	Below average	Below average
No. 4: Market and promote BC			
• Venture Capital ^(e)	↑	Average	n/a
• Foreign Direct Investment ^(e)	n/a	Below average	n/a

Notes: ^(a)Trends: Generally upwards: ↑; Little or no significant change: →; Generally downwards: ↓

^(b)Comparisons to Provinces and US States are for the latest year(s) for which data were available.

^(c)n/a = trends or comparisons were not available.

^(d)Wages reflect performance of goals no. 1 and no. 2.

^(e)Indirect measures

B. Current State — Relative to the Performance Measures Framework

This study framework includes 39 specific performance indicators grouped into four major categories:

- **Resource** indicators, which reflect the public and private **inputs** into the high tech sector.
- **Innovation** indicators, which reflect those **interactions** that translate resources into results.
- **Business enablers**, which reflect **business conditions** that influence interactions.
- **Results** indicators which reflect **outcomes** for people and business.

Within each category, **headline** indicators (of general public interest), and **detail** indicators (of particular interest to specific parties) have been developed.

1. Headline Indicators

The key study findings for the selected nine headline indicators are illustrated in Exhibit ES-2, and are described as follows:

- **Resource Indicators:** BC has experienced increasing numbers of Science and Engineering graduates during the late 1990s, but its overall levels are still generally lower than in the other jurisdictions examined. Primary/secondary education spending in BC has been increasing and is similar to the Canadian Provinces examined, but below the US jurisdictions. Post-secondary educational spending trends have been fairly steady, with expenditures tending to be higher in BC than in other Provinces, and similar to the US jurisdictions examined. While limited statistics on migration of high tech workers are available, the evidence suggests that BC's rates of inward and outward migration of workers are both above the average of the other provinces examined.
- **Innovation Indicators:** R&D expenditures trends have been flat in BC during the late 1990s. BC's R&D expenditure levels tend to be lower than in the other jurisdictions examined.
- **Business Enablers:** Corporate tax rates have been fairly steady in BC in recent years, at levels which are higher than those of the other jurisdictions examined. Personal tax rates have generally been similar to other benchmark provinces, but above US jurisdictions examined. Personal tax rates have trended downwards over the past few years, but at a lower rate than most of the other jurisdictions studied.
- **Results Indicators:** While high tech GDP has been increasing in BC, the high tech sector's portion of GDP tends to be lower in BC than in the three other provinces examined. (Comparable data are not available for the US jurisdictions). High tech employment has also grown, yet its relative economic significance also tends to be lower than for the Canadian and US benchmark jurisdictions. Wages have increased and are in line with other Canadian jurisdictions, but are considerably below US jurisdictions.

Information regarding skills needs and vacancy rates is limited, but the available evidence suggests that BC's situation is similar to that of the other provinces.

Exhibit ES-2 Headline Indicators

Headline Indicators	BC Trends ^(a)	Comparison ^(b) to	
		Provinces	US States
Resource Indicators:			
• Science & engineering graduates (# per capita)	↑	Below average	Below average
• Education spending:			
- Primary/secondary (per student)	↑	Average	Below average
- Post-secondary (per capita)	→	Above average	Average
• Migration:			
- Immigration	n/a ^(c)	Above average	n/a
- Out-migration	n/a	Above average	n/a
Innovation Indicators			
• R&D expenditures (as a % of total GDP)	→	Below average	Below average
Business Enablers			
• Tax rates:			
- Corporate	→	Less favourable	Less favourable
- Personal (overall)	→	Average	Less favourable
Result Indicators			
• High tech GDP (as a % of total GDP)	↑	Below average	n/a
• Employment	↑	Below average	Below average
• Wages earned	↑	Average	Below average
• Skills needs/ vacancy rates	→	Average	n/a

Notes: ^(a)Comparisons to Provinces and US States are for the latest year(s) for which data were available.

^(b)Trends: Generally Upwards: ↑; Little or no significant change: →; Generally Downwards: ↓

^(c)n/a: Trends or comparisons were not available.

Overall, recent BC high tech indicators have risen numerically in the areas of Resources and Results, but have been flat in the areas of Innovation and Business Enablers. Compared to other jurisdictions, most BC indicators are average or below average, and BC is not a leader in any area.

2. Detail Indicators

Benchmark data have also been gathered for 30 detail indicators of interest to particular groups.

As illustrated in Exhibit ES-3, detail indicators trends have generally been positive. However, some relatively important areas have shown negative trends, such as new business incorporations, and productivity gains.

Comparison with other jurisdictions should be interpreted with caution, as data were not available for all jurisdictions, and in some cases comparisons with only one other jurisdiction were available. (See full report for details.)

Exhibit ES-3
Detail Indicators

	Detail Indicators	BC Trends ^(a) (where available)	Comparisons ^(b) (where available)
Resource Indicators	Education levels	n/a ^(c)	Average
	Post secondary enrollment	↑	n/a
	Co-op student placements	↑	n/a
	8th and 12th-grade math and science assessments	n/a	Average
	Foreign direct investment	n/a	Below average
	Telecommunications infrastructure (per capita)	n/a	Above average
	Internet connectivity	↑	Above average
Innovation Indicators	R&D personnel	n/a	Average
	Federal research laboratories	→	n/a
	R&D intensity	↑	Average
	Joint university/industry R&D	→	Above average
	Patents and inventions	↑↓	Average
	Scientific publications	↓	n/a
	Funding for technology transfer centres	↑	n/a
	University research commercialized	↑	Below average
	New business incorporations and survival	↓	n/a
	Venture capital	↑	Average
	Initial public offerings	↑	n/a
	Market value of public high tech firms	↑	n/a
Business Enablers	Business costs	n/a	Average
	R&D tax credits	n/a	Above average
	Cost of R&D	↓	Below average
	Other incentive and support programs	↑	n/a
Result Indicators	Earnings distribution	↑	n/a
	Incentive compensation	↑	n/a
	Employee turnover	n/a	n/a
	Productivity gains	↓	n/a
	Revenues & profitability	↑	n/a
	High tech trade (exports/imports)	↑	n/a
	Technology diffusion & adoption	n/a	Below average

Notes: ^(a)Trends: Generally Upwards: ↑; Little or no significant change: →; Generally Downwards: ↓

^(b)Comparisons are for the latest year(s) for which data were available.

^(c)n/a: Trends or comparisons were not available.

C. Summary

This study clearly illustrates the paradox of BC's high tech sector. Looking within the Province, this sector's growth in recent years has been very strong, in terms of all economic indicators. On the other hand, many of BC's "current state" indicators are still behind those of the benchmark jurisdictions — Alberta, Ontario, Quebec, Washington State, Oregon and Massachusetts — examined in this report.

* * *

Further information regarding this study may be obtained by contacting:

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A copy of the complete report is available online from the Science Council of BC's website at: www.scbc.org.

I Study Framework

A. Background

Innovation and high technology are playing an increasingly important role in the growth and diversification of British Columbia's economy.

Inter-jurisdictional competition to attract high tech businesses has intensified in recent years. Regional economic growth in the high tech sector will increasingly be influenced by how effectively governments can spur technological innovation, entrepreneurship, education, specialized skills, and the development of learning networks. Constant technological innovation needs to become a given for government, private and educational institutions.

1. Defining innovation and the high tech sector

The Conference Board of Canada defines innovation as "a process through which economic value is extracted from knowledge through the generation, development and implementation of ideas to produce new or improved products, processes and services." Defining innovation as a process of extracting economic value from knowledge implies that "business" is the critical player in this process. "Business" or the high tech sector is the engine of the innovation economy.

The term "high tech sector" means different things to different people. This study has adopted the definition used by BC Statistics (BC Stats) in its "Profile of the British Columbia High Technology Sector" and the "British Columbia High Technology Sector Input Indicators Report." This includes industries that stress research and development, employ a high proportion of scientists and technicians, or produce or use technologically sophisticated products. This definition encompasses all or part of twenty manufacturing industries (such as Aircraft and Aircraft Parts, Communications and other Electronic Equipment) and three service industries (such as Computer and Related Services, Engineering Services). A list of high tech industry and services sectors is included in Appendix B – Approach and Methodology.

Data obtained from sources other than BC Stats, may be based on different definitions of the high tech sector and jurisdictional comparisons should be viewed with caution. The reader is strongly advised to consult primary sources to assess the comparability of data, prior to drawing firm conclusions in any specific area.

2. BC High Tech Strategy

In 1999, a multi-stakeholder group, coordinated by the Province of British Columbia and including high tech industry and education leaders, developed the "BC High Tech Strategy". The High Tech Strategy outlines the goals, principles for action, and objectives for the high tech sector, documents the successes achieved to date, and charts a course toward continued growth. It provides a vision in which responsibilities for supporting growth are shared by government, industry and education.

The four key goals of the BC High Tech Strategy are to:

- Make British Columbia the place of choice in high tech business.
- Develop and attract outstanding talent.
- Strengthen British Columbia's research and development capability.
- Market and promote British Columbia.

For each of these four goals, the BC High Tech Strategy also explicitly identifies the need to establish appropriate performance indicators, and to measure progress. Each of these four goals includes, as one of its sub-objectives, the identification and implementation of performance measurement indicators.

3. Defining key performance indicators and baseline measures

In 1999, the Science Council of BC was tasked by the Provincial Government to lead the definition of key performance indicators for the BC high tech sector, and to direct the development of an initial set of baseline performance measures. To direct this project, the Science Council formed a Performance Measures Committee (PMC), composed of representatives from industry, academia, and government.

This Committee's mandate was to "identify and implement performance measures to evaluate progress in the achievement of goals of the BC High Tech Strategy". The Committee's major responsibilities are to oversee the development, identification, and implementation of performance indicators for the BC high tech sector, and to undertake activities to disseminate information about the structure and relative performance of the high tech sector and innovation economy in BC.

The Performance Measures Committee developed the framework for performance measurements, including organization of indicators into headline and detail indicators, criteria for selection of indicators, and guidelines on the report production. The Committee also reviewed the BC High Tech Strategy and identified an initial set of 57 relevant performance indicators, described their significance in the context of an innovation economy, and identified 157 corresponding data sets. The Science Council of BC engaged KPMG on PMC's behalf, to:

- Validate the initial list of performance indicators.
- Determine availability of data and costs of data collection.
- Recommend appropriate indicators as headline and detail indicators and corresponding data sets.
- Recommend jurisdictions for benchmarking.
- Recommend BC industry sectors to compare to the high tech sector.
- Collect data and, where direct measures are not available, recommend alternatives.
- Develop a report assessing the state of the high tech sector in BC (for approval by PMC and the Science Council).

Two papers developed by the Science Council under the PMC's leadership were used as a springboard for this study:

- The first report "Definitions and Models of High Technology Industry and Innovation Economy: A Comparative Review" presents a comparative review of industries classified as high technology and of concepts of innovation economy in selected jurisdictions (BC, Alberta, Manitoba, Ontario, Quebec, Massachusetts, Washington and Oregon).
- The second paper "A Model of the BC High Technology Sector: Description of Factors and Linkages Affecting Growth of the High Technology Sector in the Context of an Innovation Economy" is a composite presentation of critical elements of an innovation economy, and how they are applied to the analysis of performance of the high tech sector. It also lists a collection of indicators currently used in various jurisdictions to measure these critical elements.

B. Performance measurement framework

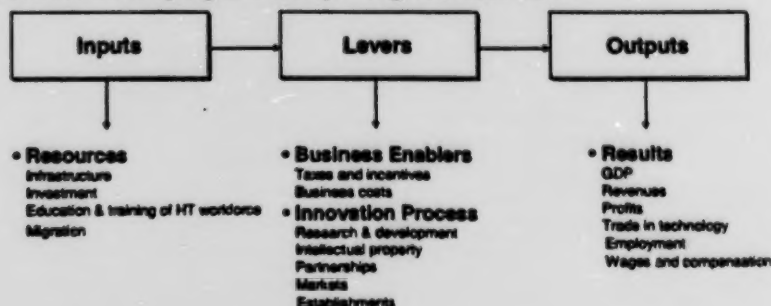
KPMG utilized the framework provided by the PMC in developing performance indicators which will guide readers in understanding the results.

The framework, as illustrated in Exhibit I-1, was adapted from the Massachusetts Innovation Index. It is based on a concept that links resources to economic results through innovation and business levers, organizing performance indicators into four interrelated and interactive measures:

- **Resources:** public and private inputs. Resource indicators measure the critical inputs that the high tech sector needs to improve and sustain its competitive advantage.
- **Innovation:** interactions that translate resources into results. Innovation indicators are technical, scientific, commercial and/or financial resources that help generate knowledge and ideas and support a technology-based industry.
- **Business enablers:** business conditions that influence interactions. Business enablers are indicators of the business climate in which innovative ideas and technology-based products are being promoted and developed.
- **Results:** outcomes for people and business. Results indicators measure the impact of the high tech sector in terms of benefits to business and people, and the overall effect on economy and society.

Exhibit I-1

Framework for developing and interpreting indicator data



1. Headline and detail indicators

In a global economy benchmark comparisons can provide an important context for understanding how BC is performing in relation to competing jurisdictions. One of the objectives of the performance measurement system is to benchmark the BC high tech sector to other leading jurisdictions in North America. Performance measures also describe trends over a period of time, and indicators must be reliable and measurable on an ongoing basis. Another goal of the study is to compare the high tech sector to other BC industries in key areas.

To meet these various criteria, the framework recommended by PMC, and used by KPMG, organizes the indicators into two sections: headline and detail indicators.

- **Headline indicators** benchmark the performance of BC's high tech sector with that of leading jurisdictions in Canada and the US, and with other BC sectors. These are indicators where public interest is most active.
- **Detail indicators** present BC trends and some benchmark data, and help analyze how the BC high tech sector has been performing and where it's going.

2. BC high tech performance measurement system

Using the framework described above, the high tech performance measurement system covers nine headline and 30 detail indicators, for a total of 39 indicators, as summarized in Exhibit I-2 below. These indicators are also linked to the four BC High Tech Strategy goals:

1. Make BC a place of choices
2. Develop and attract talent
3. Expand research and development
4. Market and promote BC.

Exhibit I-2
High tech performance measurement system

	Headline Indicators	BC High Tech Strategy goals ⁽¹⁾	Detail Indicators	BC High Tech Strategy goals ⁽¹⁾
Resource Indicators	Science & engineering graduates	2	Education levels	2
	Education spending	2	Post secondary enrolment in high tech disciplines	2
	Migration	2,4	Co-op student placements	2
			Eight & 12th-grade math and science assessments	2
			Foreign direct investments	1,4
			Telecommunications infrastructure	1
			Internet connectivity	1

	Headline Indicators	BC High Tech Strategy goals ⁽¹⁾	Detail Indicators	BC High Tech Strategy goals ⁽¹⁾
Innovation Indicators	Research & development (R&D)	3	R&D personnel	3
			Federal research laboratories	3
			R&D intensity	3
			Joint University/Industry R&D	3
			Patents and inventions	3
			Scientific publications	3
			Funding for technology transfer centres	3
			University research commercialized	3
			New business incorporations and survival	1,4
			Venture capital	1,3,4
			Initial public offerings	1,4
			Market value of public high tech firms	1
Business Enablers	Tax rates	1	Business costs	1
			R&D tax credits	1,3
			Cost of R&D	1,3
			Other provincial incentive and support programs	1,3
Results Indicators	GDP	1	Earnings distribution	1,2
	Employment	1	Incentive compensation	2
	Wages earned	1,2	Employee turnover	2
	Skills needs/ vacancy rates	2,4	Productivity gains	1
			Revenues & profitability	1
			High tech trade (imports, export markets)	1,3, 4
			Technology diffusion	1,3

(1) Relevance to the BC High Tech Strategy goals:

1. Make BC a place of choice
2. Develop and attract talent
3. Expand research and development
4. Promote and market BC

C. How this study complements other performance measurement sources

Other studies on the BC high tech sector have been published in British Columbia. BC Stats and the BC Information, Science and Technology Agency (ISTA) have been publishing an annual "Profile of the British Columbia High Technology Sector", which contains information on BC high tech sector's outputs, including gross domestic product (GDP), employment, wages and salaries, revenues, establishments, and exports and imports. This year BC Statistics and ISTA have also published a companion report entitled "The BC High Technology Sector Input Indicators Report - The 1990s". This report tracks the evolution of 42 input indicators from educational, business, government, external and labour sectors, and compares BC to Alberta, Ontario and Quebec in those areas.

The BC Technology Industries Association also publishes an annual "BC Technology ReportCard". The "BC Technology ReportCard" summarizes results from a survey of CEOs representing a sample of BC's technology companies. The survey covers areas such as employment, revenue and profitability profile, geographical representation, sectoral breakdown, investment climate, compensation, skills, and recruitment.

The above reports have tended to focus on inputs and outputs. This study goes one step further and integrates inputs, outputs and innovation in one document. It covers innovation indicators such as R&D expenditures and personnel, R&D cost and tax credits, funding of national research agencies, and technology diffusion. It also includes educational indicators such as education spending, post-secondary graduates and enrolment, and co-op placements. For nine major "headline" indicators, it also compares BC to three US States (Washington, Oregon and Massachusetts) in addition to the three provinces of Alberta, Ontario and Quebec.

D. Study scope and methodology

The focus for data collection and analysis is defined by the framework which, as indicated above, is organized into headline and detail indicators.

In this first effort to illustrate trends in innovation and technology, data for up to three years have been included, where available.

1. Headline indicators

Headline indicators include benchmarks to Canadian and US jurisdictions and sectoral comparisons to key BC industries.

- **Benchmark comparisons** include jurisdictions which are strong competitors to BC or industry leaders:
 - Canada: Alberta, Ontario, and Quebec
 - US: Washington, Oregon and Massachusetts

Headline indicators are benchmarked for British Columbia and for selected jurisdictions in areas where comparable data were available. BC trends and trend comparisons to other jurisdictions are also provided for, where data were available.

- **Sectoral comparisons** to BC's high tech industry have been provided for forestry, tourism, finance/insurance and real estate (FIRE), and the film industry. These sectors were selected for their importance to the BC economy and/or their high growth. BC sectoral comparisons include GDP and employment.

2. Detail indicators

Detail indicators are all benchmarked for British Columbia. Jurisdictional benchmarks, sectoral comparisons and BC trend comparisons are also provided where data were readily available and comparisons meaningful.

3. Data selection criteria and analysis

In collecting datasets and deciding whether and how to use them in this report, a number of criteria have been considered, including:

- (1) Relevance to the subject of the headline/detail indicator.
- (2) Comparability of data collection method to the data collection method in BC.
- (3) Reliability of data and data sources.
- (4) Availability of comparable data over a period of three years.

The reader is cautioned that the information contained in this document is drawn from hundreds of primary and secondary research data sources, and that many of the inter-jurisdictional and inter-sectoral comparisons can be expected to have issues relating to the consistency of measurement approaches among jurisdictions and sectors.

In interpreting and further analyzing the specific charts and tables contained in this report, the reader is strongly encouraged to also review the primary sources from which they are drawn, and to perform an independent assessment of the comparability issues regarding specific datasets. KPMG will not be responsible for any decisions undertaken by other parties based on the contents of this report.

E. Detailed information

Sources and references are listed in Appendix A and are referenced in the charts.

Approach and Methodology details are in Appendix B.

A full copy of this report is available online from the Science Council of BC's website at: www.scbc.org

II Headline Indicators: Measuring BC's Performance

A. Headline indicators summary

1. BC's innovation and technology performance

Exhibit II-1 below presents a quick overview of headline indicators, showing BC trends in recent years, and comparisons to Canadian provinces and US States. Comparable data to other jurisdictions (particularly for US States), for "Migration" and "Skills Needs/Vacancy Rates" were limited, and the rating for these two indicators should be considered as a general observation.

The arrows indicate whether an indicator has generally numerically risen (↑), dropped (↓), or remained substantially unchanged (→) over the period for which the indicator data are available. This assessment relates to BC trends only.

Comparisons to average performance of benchmark provinces (Alberta, Ontario and Quebec) and US States (Washington, Oregon and Massachusetts) are made by ranking British Columbia as being generally numerically above, below, or substantially equal to the benchmark jurisdictions. It is important to note that an indicator which has risen, or is labelled "above average" does not necessarily indicate an advantage for the BC high tech sector. This depends on how each indicator is likely to influence high tech performance. For example, above average taxes or above average out-migration would normally be considered as negative factors by the high tech industry.

Key study findings for headline indicators are illustrated in Exhibit II-1 and summarized as follows:

- **Resource Indicators:** BC has experienced increasing numbers of Science and Engineering graduates during the late 1990s, but its overall levels are still generally lower than in the other jurisdictions examined. Primary/secondary education expenditures in BC have been increasing and are similar to the Canadian Provinces examined, but below the US jurisdictions. Post-secondary educational spending trends have been fairly steady, with expenditures tending to be higher in BC than in other Provinces, and similar to the US jurisdictions examined. While limited statistics on migration of high tech workers are available, the evidence suggests that BC's rates of inward and outward migration of workers are both above the average of the other provinces examined.
- **Innovation Indicators:** R&D expenditures trends have been flat in BC during the late 1990s. BC's R&D expenditure levels tend to be lower than in the other jurisdictions examined.
- **Business Enablers:** Corporate tax rates have been fairly steady in BC in recent years, at levels which are higher than those of the other jurisdictions examined. Personal tax rates have generally been similar to other benchmark provinces, but above US jurisdictions

Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

examined. Personal tax rates have trended downwards over the past few years, but at a lower rate than most of the other jurisdictions studied.

- **Results Indicators:** While high tech GDP has been increasing in BC, the high tech sector's portion of GDP tends to be lower in BC than in the three other provinces examined. (Comparable data are not available for the US jurisdictions). High tech employment has also grown, yet its relative economic significance also tends to be lower than for the Canadian and US benchmark jurisdictions. Wages have increased and are in line with other Canadian jurisdictions, but are considerably below US jurisdictions. Information regarding skills needs and vacancy rates is limited, but the available evidence suggests that BC's situation is similar to that of the other provinces.

Exhibit II-1

BC Trends and Performance In Comparison to Benchmark Jurisdictions⁽¹⁾

Headline Indicators	BC Trends ⁽²⁾	Comparison to Provinces	US States
Resource Indicators:			
• Science & engineering graduates (# per capita)	↑	Below average	Below average
• Education spending:			
- Primary/secondary (per student)	↑	Average	Below average
- Post-secondary (per capita)	→	Above average	Average
• Migration:			
- Immigration	n/a ⁽³⁾	Above average	n/a
- Out-migration	n/a	Above average	n/a
Innovation Indicators			
• R&D expenditures (as a % of total GDP)	→	Below average	Below average
Business Enablers			
• Tax rates:			
- Corporate	→	Less favourable	Less favourable
- Personal (overall)	→	Average	Less favourable
Results Indicators			
• High tech GDP (as a % of total GDP)	↑	Below average	n/a
• Employment	↑	Below average	Below average
• Wages earned	↑	Average	Below average
• Skills needs/ vacancy rates	→	Average	n/a

Notes:

⁽¹⁾Comparisons to Provinces and US States are for the latest year(s) for which data were available.

⁽²⁾Trends = Generally Upwards: ↑; Little or no significant change: →; Generally Downwards: ↓

⁽³⁾n/a = Trends or comparisons were not available.

Overall, recent BC high tech indicators have risen numerically in the areas of Resources and Results, but have been flat in the areas of Innovation and Business Enablers. Compared to other jurisdictions, most BC indicators are average or below average, and BC is not a leader in any area.

Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

2. BC's performance relative to the High Tech Strategy goals

When we analyze BC's performance from the BC High Tech Strategy perspective, we obtain a similar picture.

- **Goal #1 – Make BC a Place of Choice.** As illustrated in Exhibit II-2, high tech GDP, employment, and wages show rising trends in BC in recent years, while tax rate trends have generally remained flat. On the other hand, the relative significance of BC's high tech industry tends to be lower than the other US and Canadian jurisdictions studied.
- **Goal #2 – Develop and Attract Talent.** BC's post-secondary education spending is above the Canadian average, although recent trends have been flat. Wages, primary/secondary education expenditures, and skills needs are at about the Canadian average, but are generally below US levels. Generally, BC's levels of effort in developing and attracting talent appear similar to other major provinces, but below the US jurisdictions examined.
- **Goal #3 – Expand Research and Development.** Recent trends in BC have been flat, and BC's statistics do not compare well with the other Canadian and US jurisdictions examined. While R&D tax incentives were introduced in 1999 in British Columbia, the impact of these incentives would not yet be reflected in R&D statistics.
- **Goal #4 – Market and Promote BC.** The linkages between the headline indicators examined and this goal tend to be indirect. However, for two of the detail indicators we have identified some data which provide some insight into BC's performance. Compared to benchmark provinces, BC is average in terms of Venture Capital and below average in terms of Foreign Direct Investment.

Exhibit II-2 Summary of High Tech Strategy Performance

Goals	BC Trends ^(a)	Comparison ^(b) to	
		Provinces	US States
No. 1: Make BC a Place of Choice			
• High Tech GDP (as a % of total GDP)	↑	Below average	n/a ^(c)
• Employment	↑	Below average	Below average
• Wages Earned ^(d)	↑	Average	Below average
• Tax rates:			
- Corporate	→	Less favourable	Less favourable
- Overall personal	→	Average	Less favourable

Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

Comparison ^(b) to			
No. 2: Develop and attract talent			
• Spending on Education:			
- Primary/Secondary (per student)	↑	Average	Below average
- Post-secondary (per capita)	→	Above average	Average
• Science & engineering graduates (# per capita)	↑	Below average	Below average
• Wages Earned ^(d)	↑	Average	Below average
• Skills Needs	→	Average	n/a
No. 3: Expand research & development			
• R&D Expenditures (as a % of total GDP)	→	Below average	Below average
No. 4: Market and promote BC			
• Venture Capital ^(e)	↑	Average	n/a
• Foreign Direct Investment ^(e)	n/a	Below average	n/a

Notes: ^(a)Trends: Generally upwards: ↑; Little or no significant change: →; Generally downwards: ↓
^(b)Comparisons to Provinces and US States are for the latest year(s) for which data were available.
^(c)n/a = trends or comparisons were not available.
^(d)Wages reflect performance of goals no. 1 and no. 2.
^(e)Indirect measures

3. How does high tech compare to other BC industry sectors?

The high tech sector is one of the few BC industry sectors that has shown significant growth, both in terms of employment and GDP, in recent years. Exhibit II-3 provides comparative figures on high technology, forestry, finance/insurance and real estate (FIRE), film, and tourism. Comparisons are presented on employment and GDP, and an arrow demonstrates past trends.

Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

Exhibit II-3
Comparing High Tech to Other BC Sectors

Sector	Employment			GDP		
	Workers (1999)	Average annual change (97-99)	Trends ^(a)	GDP 1998 Constant (\$ in M)	Average annual change (96-98)	Trends
High Tech	52,000	8.1%	↑	2,640	5.6%	↑
Forestry	85,700	-0.4%	↓	4,632	-4.6%	↓
FIRE ³	88,100	-0.5%	↓	8,738	2.4%	↑
Film	3297	8.0%	↑	164	5.5%	↑
Tourism	106,830	-1.8%	↓	4,292	1.5%	↑
BC overall	1,480,000	1.0%	↑	89,000	1.4%	↑

Source: BC Stats

Notes: ^(a)Trends: Generally upwards: ↑; Little or no significant change: →; Generally downwards: ↓

Employment in the high tech sector increased faster than in any other sector examined at an annual average rate of 8.1% over the period 1997 to 1999. BC's employment average growth rate was 1%, while three major sectors, Forestry, FIRE and Tourism experienced a decrease in employment. High tech GDP also showed the highest growth of sectors examined, with an average annual increase of 5.6% during the same period, confirming that high tech is one of the fastest growing sectors in BC.

4. BC's strengths and weaknesses in innovation and technology

As mentioned above, all indicators are generally equal to, or below, benchmark jurisdictions, and they show some weaknesses, particularly when compared to the US States. Critical factors for the high tech sector include a skilled workforce, R&D support, and tax rates, and in all three, BC is trailing or just keeping up with the competition.

5. Areas complementing the BC Stats high tech profile and input indicators

The comparative results to US jurisdictions provide a new perspective on the BC high tech sector's competitive performance within a North American economy. In addition, high tech GDP comparisons to Canadian jurisdictions illustrate the strengths/weaknesses of the BC high tech sector in comparison to the other major provinces.

³ FIRE = Finance, Insurance & Real Estate

Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

B. Resource Indicators

1. Science And Engineering Graduates

Why is this significant?

Science and engineering graduates are essential to the growth of an innovation economy as they tend to be leaders in creating new products and ideas in the high tech sector. The potential pool of new engineers and scientists is an important indicator of a skilled workforce in the future.

How has BC performed?

The number of University Bachelors degrees in Science and Engineering (S&E) in 1997/98 was lowest in BC with 47 per 100,000 population. The top jurisdiction was Massachusetts with 208. When comparing the number of Bachelors degrees in S&E as a proportion of total Bachelors degrees, BC was also low with 15%, while Massachusetts again was at the top with 31%. (Figure 1)

Looking at Bachelors degrees in Computer Sciences, BC is faring a little better with 7 per 100,000 of population, the same as Alberta, but higher than Washington State at 5 per 100,000 population. Massachusetts was the top one with 27. (Figure 2)

Trends

The number of BC graduates who earned a bachelors degrees or a diploma in Computer Sciences has increased from 1,893 in 1995 to 2,260 in 1998. (Figure 3)

Summary

Although past trends have been positive, the number of BC graduates in computer sciences and engineering have generally been lower than in the other jurisdictions examined.

Figure 1

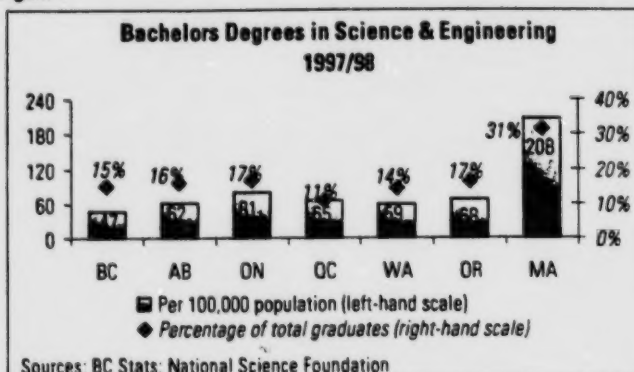


Figure 2

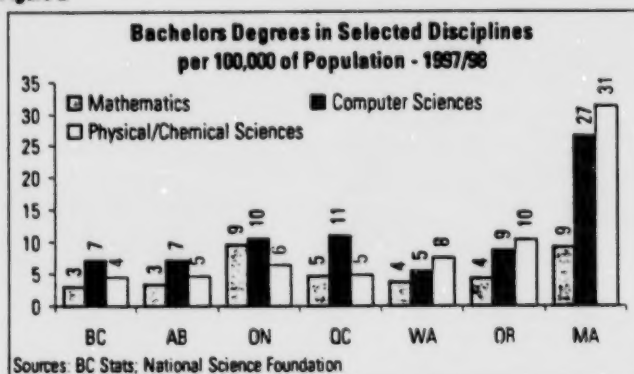
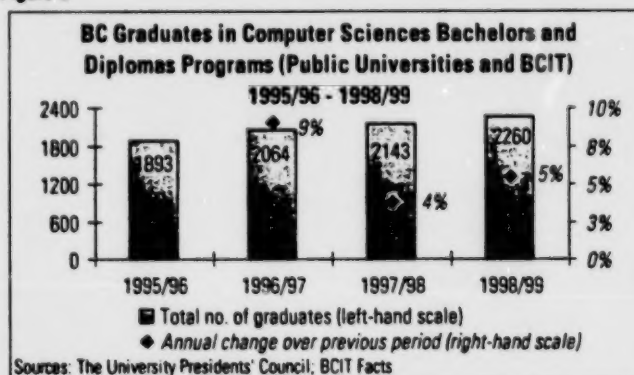


Figure 3



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

2. Education Spending

Why is this significant?

Education spending is an indicator of government's commitment to investing in a future skilled workforce. An educated workforce, capable of using knowledge to generate innovation, is critical to a knowledge-based industry which relies heavily on highly educated people to grow and be competitive.

How has BC performed?

Primary/secondary education spending (K12)

In Canada, of the provinces examined, Quebec spent the highest amount at \$7,300 per student on Kindergarten to Grade 12 (K-12) education. BC and Ontario followed, at \$6,900 per student. Of all benchmark jurisdictions, Massachusetts' spending was the highest at Cdn \$13,100 per student, followed by Washington at Cdn \$11,700. (Figure 4)

Post-secondary education spending

Post-secondary expenditures per capita in 1996 in Canadian benchmark provinces were highest in Quebec with \$800, followed by BC with \$760. Of all jurisdictions, Massachusetts spent the most with Cdn \$1,770 per capita. (Figure 5)

Total spending on education

Three out of four benchmark provinces had nearly equal expenditures on total education in 1996, on a per capita basis. BC, Ontario and Quebec spent about \$2,000 per capita, and Alberta \$1,930. Of all jurisdictions, Massachusetts was the highest at Cdn \$3,420 per capita. (Figure 6)

Figure 4

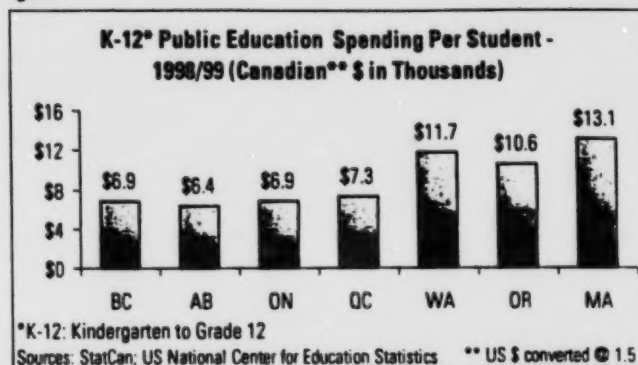


Figure 5

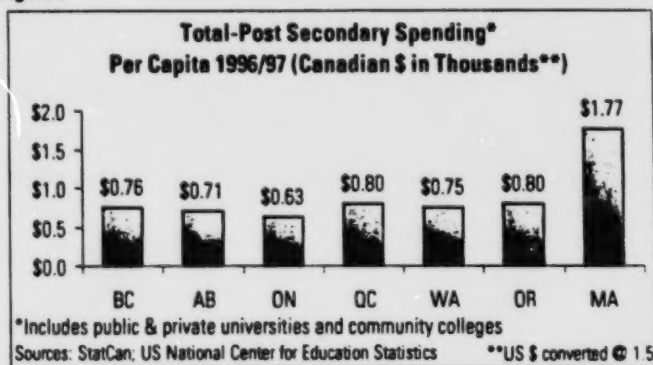


Figure 6



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

Trends

In K-12 education spending, Alberta had the biggest increase of benchmark provinces, with a compound rate of 7.5% from 1995 to 1998. BC's education spending increased 4.6% during the same period, while Ontario and Quebec decreased by 2.8% and 2.9% respectively. (Figure 7)

In post-secondary education, BC was the only Canadian province examined without an overall spending decrease, as expenditures remained constant from 1995 to 1998. Quebec showed the largest decrease with 2.1%, followed by Alberta at 1.3% and Ontario at 0.5%.

In BC, total education expenditures increased from \$7.58 billion in 1995 to \$7.80 billion in 1998, a compound increase of 2.8%. (Figure 8)

Summary

Indicators on education spending show mixed results. Of all jurisdictions examined, BC's spending on K-12 is at the provincial average, but below US State average, while spending on post-secondary education is slightly above provincial average and generally equal to US State average.

Figure 7

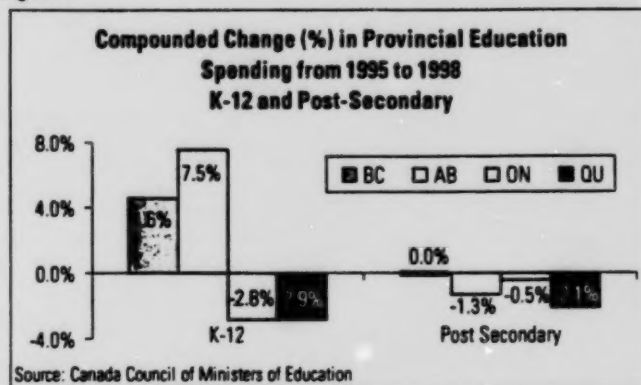
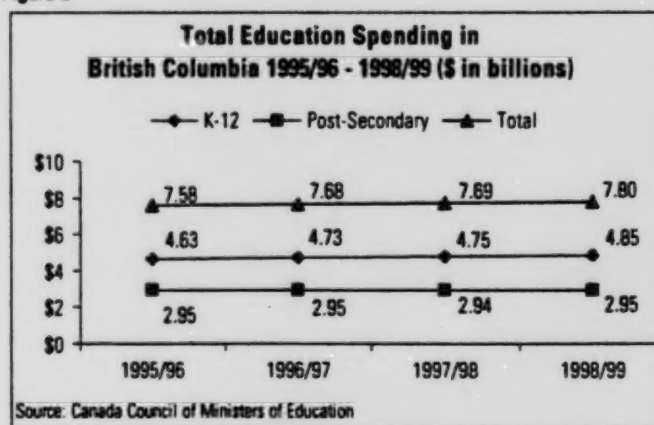


Figure 8



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

2. Migration

Why is this significant?

Migration reflects the flow of trained and skilled manpower in and out of the province. It measures the high tech sector's ability to retain its professional and technical workers and the sector's dependency on workers from outside the province.

How has BC performed?

Immigrants with high tech related occupations

BC received a fair share of immigrants with high tech related occupations during the period 1990-1996. High tech immigrants to BC accounted for 17% of Canadian high tech immigrants. BC accounts for 13% of Canadian population. Ontario received the highest number of the provinces examined with 55% of total high tech immigrants, and Alberta the lowest with 7%. (Figure 9).

These figures represented a ratio of 3.43 high tech immigrants per 1,000 of total immigration to BC, the second highest after Ontario with 3.92 per 1,000. (Figure 10)

Migration to the US

It's difficult to get accurate numbers of migrating workers to the US on a provincial basis. At the Canadian level, the ratio of Outflow/Inflow from permanent migration between Canada and the US is highest among Engineers and Managerial Occupations with a ratio of 6.7 and 6.5 respectively. (Figure 11)

Figure 9

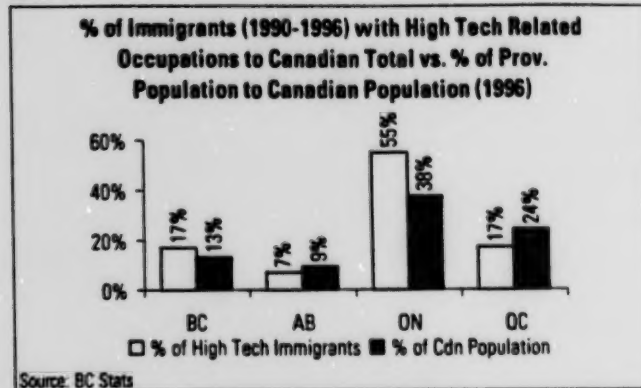


Figure 10

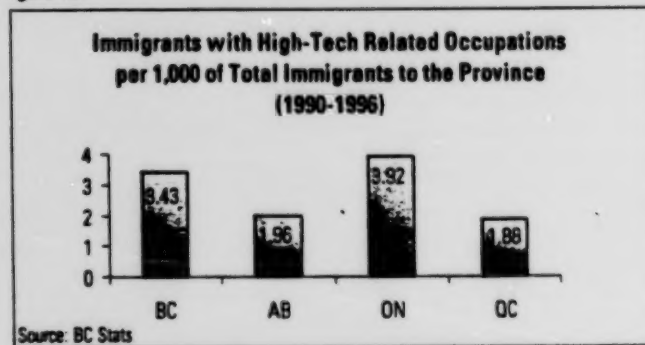
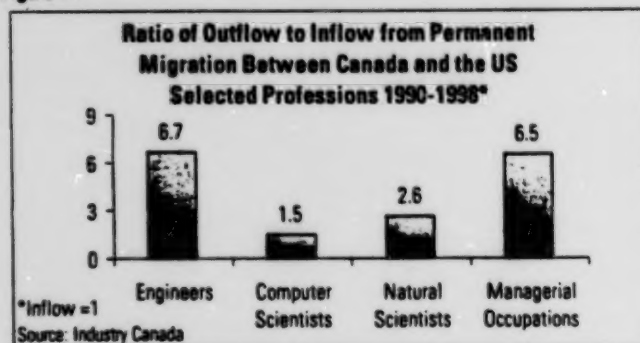


Figure 11



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

In BC, the results of a 1996 BC graduates survey indicate that five years after graduation, a significant proportion of science and engineering graduates are working in the US, particularly from SFU (33%). (Figure 12)

Another indication of the fairly high percentage of BC high tech workers departing for the US is illustrated in the survey results of the BCTIA ReportCard 1999 and the AltaTech Report 2000. In BC, 22% of high tech employees leaving BC firms are going to the US, and 52% join other firms in the Province. In Alberta, only 4% are known to go the US and 67% remain in the Province. (Figure 13)

Summary

BC is receiving more than its share of Canadian immigrants with high tech related occupations. However, migration of high tech workers to the US or outside the province, is higher in BC than in Alberta.

Figure 12

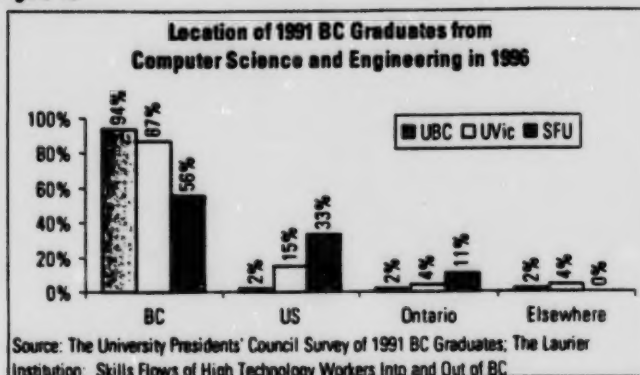
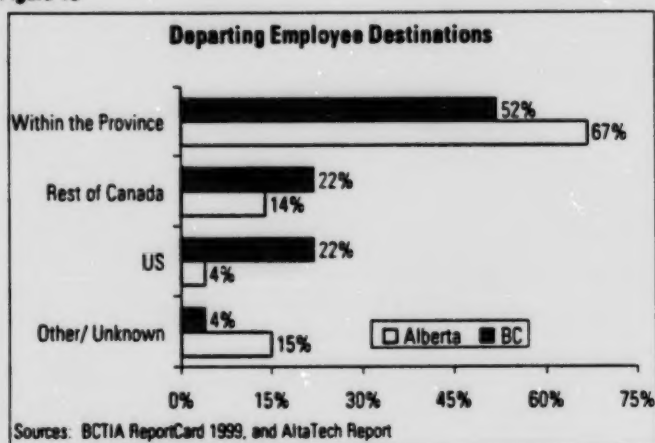


Figure 13



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

C. Innovation Indicators

1. Research & Development

Why is this significant?

Research and development (R&D) is essential for developing new products, processes and encouraging innovation. R&D spending is an important innovation indicator as research generates new ideas and new products.

How has BC performed?

Total R&D expenditures⁴

Expenditures on R&D in BC are below most other benchmark jurisdictions, when compared as a percentage of total GDP. In 1997, BC and Alberta had lower rates at 1.1% and 1.0% of GDP respectively, and Massachusetts the highest at 5%. (Figure 14)

When comparing to high tech provincial GDP, proportion of R&D expenditures in Natural Sciences & Engineering (NSE) in BC are second highest at 37.6% after Quebec at 43.3%. (Figure 15)

Provincial R&D

BC Provincial government R&D expenditures in Natural Science & Engineering (NSE) have fluctuated slightly from 1995 to 1999 but have actually decreased in the past three years. They have also been consistently the lowest of the benchmark provinces over the period. (Figure 16).

Figure 14

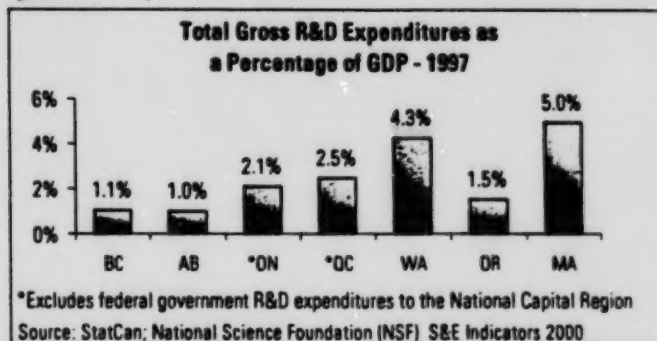


Figure 15

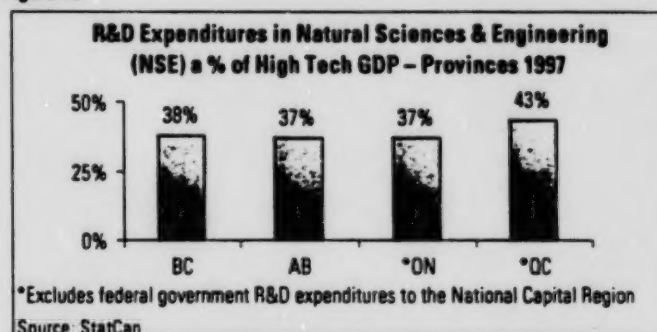
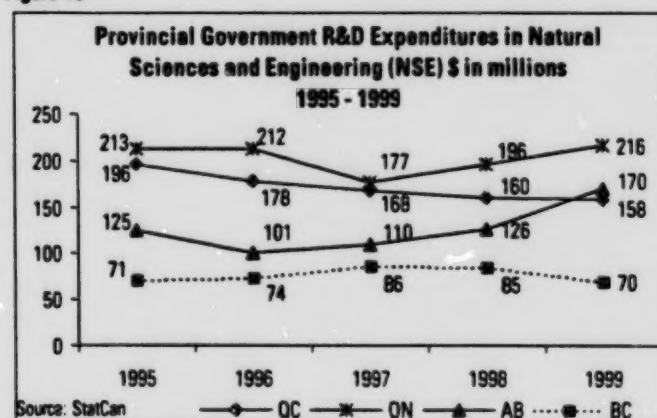


Figure 16

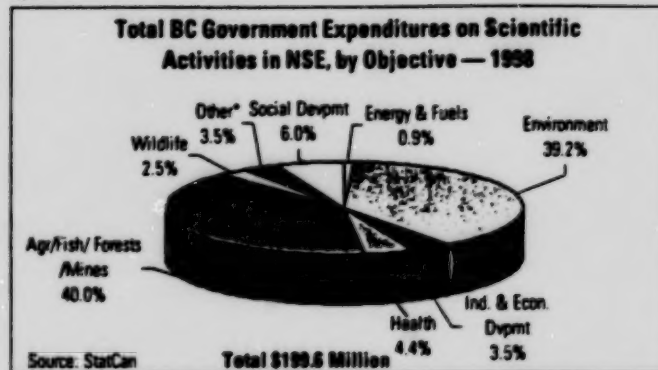


⁴ Research & Development expenditures include total expenditures expended, regardless of performing sectors, unless specified otherwise.

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Figure 17

In 1998, nearly 80% of the BC provincial government expenditures on scientific activities in NSE were in the resources and environment areas, with 40% to agriculture, fisheries, forests and mines, and 39.2% to environment. (Figure 17)



*Other includes: Advancement of science, communications, manufacturing, transport and other unclassified

Figure 18

Industry R&D

In 1997, industry spent close to half of the R&D expenditures in BC, but was the lowest of the jurisdictions examined at 44% of total. Oregon's industry spent the highest with 71% of total R&D expenditures. (Figure 18) (Data for Washington State is not available)

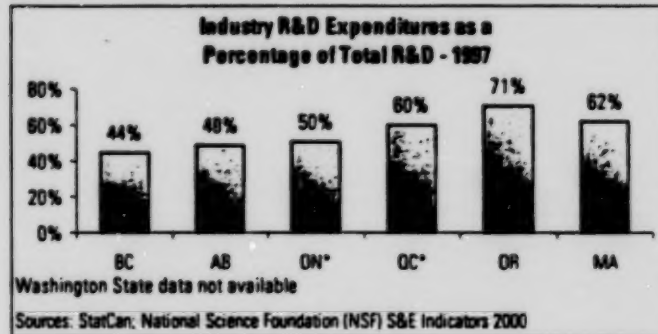
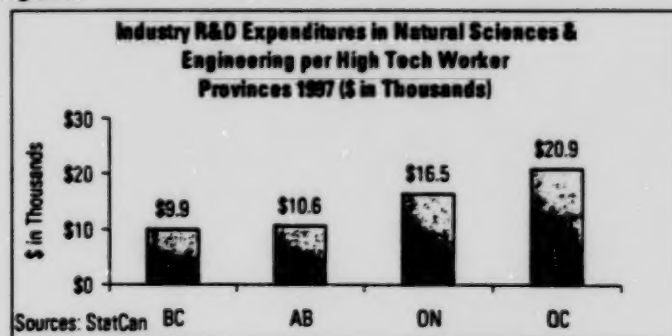


Figure 19

Industry spent \$9,900 per high tech worker on R&D in NS&E in BC in 1997, the lowest of the benchmark provinces. The ratio was highest in Quebec with \$20,900 per employee. (Figure 19)



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

Federal Government R&D

Federal Government R&D expenditures represented 21% of total R&D expenditures in BC in 1997. This is the highest percentage of the Canadian provinces examined. The highest federal contribution to R&D, of all jurisdictions examined, was in Massachusetts with 35% of total R&D expenditures. (Figure 20)

Expenditures in R&D performed by Higher Education

Alberta higher education expenditures represented 31% of total R&D expenditures in the province in 1997, the highest percentage of surveyed jurisdictions. BC was second with 29%. (Figure 21)

Trends

Recently, R&D Expenditures have increased at a low rate in benchmark provinces compared to US States. Washington had a large increase of 43.9% in R&D from 1995 to 1997. BC had the lowest increase of all jurisdictions examined with 3.7%. Alberta and Ontario increased by 7.7% and Quebec by 9.9%. (Figure 22).

Summary

R&D expenditures have generally been lower in BC than in other jurisdictions examined. Recent BC trends are showing marginal increases, but much smaller than benchmark jurisdictions.

Figure 20

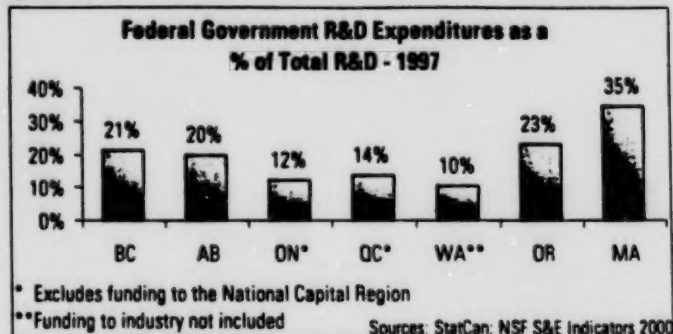


Figure 21

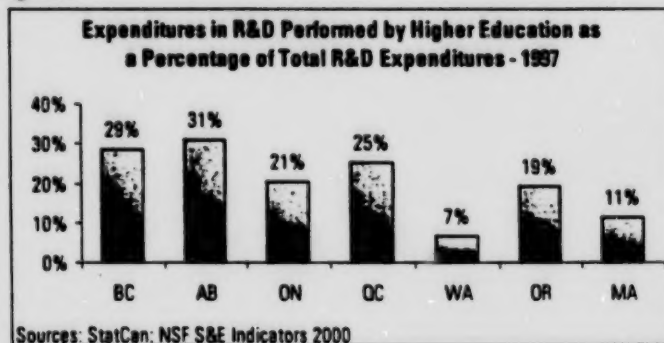
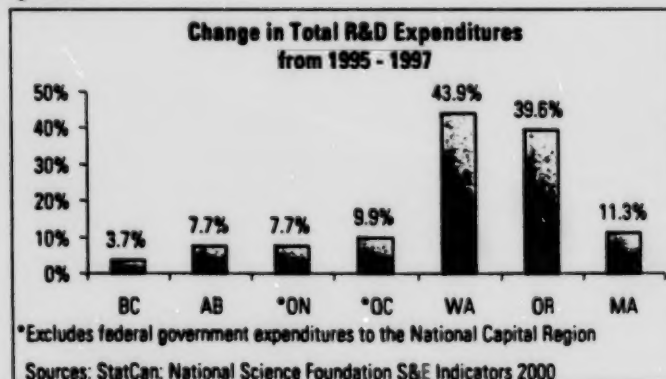


Figure 22



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

D. Business Enablers

1. Tax Rates

Why is this significant?

The effective tax rate is a highly relevant measure of a region's global competitiveness. Low corporate and business taxes make a region attractive for business. On the other hand, high personal income taxes make it difficult to recruit and retain skilled employees.

How has BC performed?

Effective corporate tax rate

For small businesses, BC had the lowest top combined (provincial/federal) tax rates of benchmark provinces in 1999 at 18.6%. However, for large manufacturing firms, BC had the highest combined rate at 38.6%. (Figure 23)

For a large non-manufacturing firm BC had the highest top combined tax rate of US and Canadian benchmark jurisdictions in 1999 with a rate of 45.6%. Note: Washington State is not included as comparison is difficult because tax is also paid on receipts (Figure 24).

In 1999, BC also had the highest top provincial/state corporate tax rate at 16.5%. (Figure 25).

Figure 23

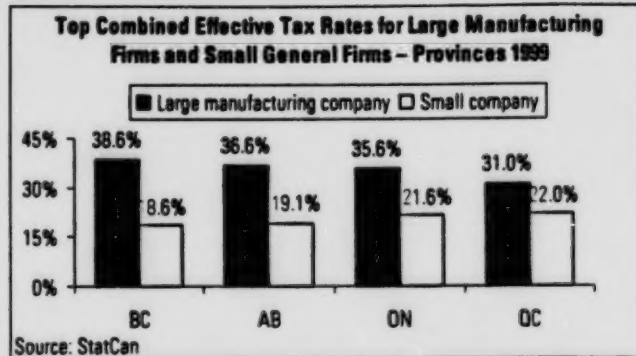


Figure 24

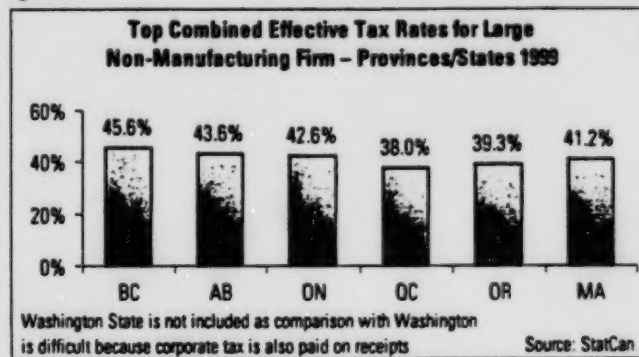
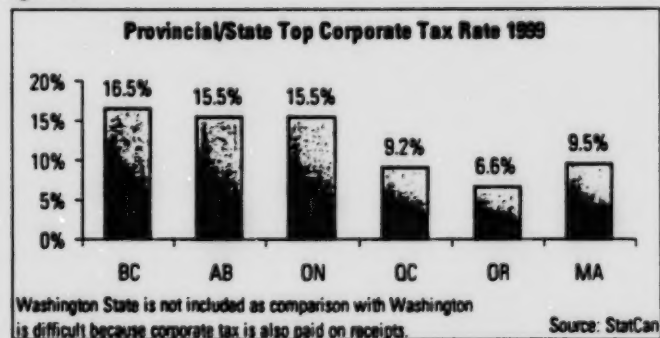


Figure 25



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

Personal income taxes and statutory benefit deductions

For a single individual earning \$80,000 in 1999, of all surveyed jurisdictions, Quebec had the highest rate of effective personal income taxes and statutory benefit deductions with 42.5%. British Columbia followed at 36.8%. Washington State was the lowest of all jurisdictions examined at 25.7%. (Figure 26)

Total BC personal taxes³ are generally average compared to benchmark provinces. (Figure 27)

Trends

Total personal taxes have decreased slightly in recent years, with a rate of 35.7% in 1997 (for a single unattached individual earning \$80,000) down to 35.1% in 1999. This decrease is lower than in Alberta and Ontario. (Figure 27)

BC corporate tax rates have not changed in the past few years.

Summary

Effective corporate tax rates are generally higher in BC than in other jurisdictions, except for small firms. Also, the BC provincial corporate tax rate is the highest of all jurisdictions examined.

BC's rate of personal income taxes and statutory benefit deductions is higher than in benchmark jurisdictions. Total BC's personal taxes, compared to the provinces examined, are average.

Figure 26

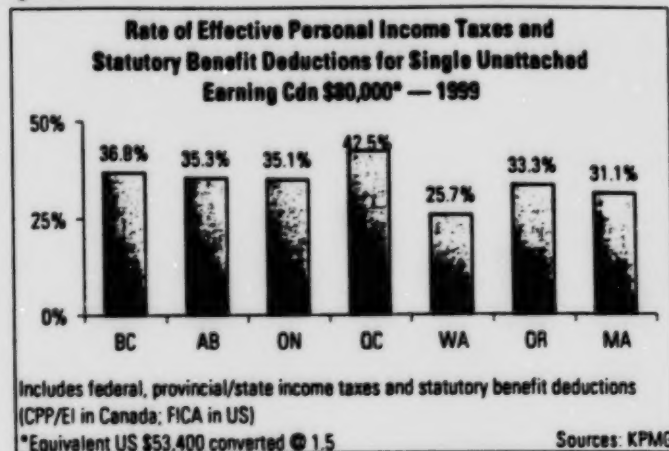
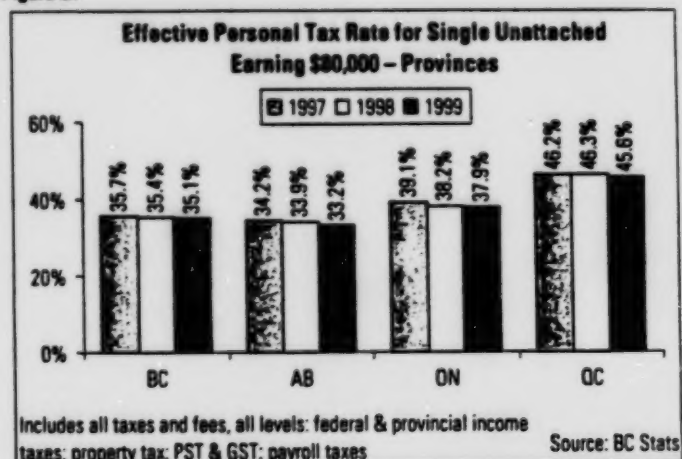


Figure 27



³ Includes all taxes and fees, all levels: federal & provincial income taxes; property tax; PST & GST; payroll taxes.

Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

E. Results Indicators

1. Gross Domestic Product

Why is this significant?

Gross Domestic Product measures the value added to an industry and is an important indicator of the sector's contribution to the overall economy. GDP size and growth indicates whether the sector has the power to serve as a leader in the province's economic growth.

How has BC performed?

High tech GDP amounted to \$2,680 million (current \$) in 1998 in BC. As a proportion of total provincial GDP, BC high tech GDP was the lowest of the benchmark provinces with 2.4%. Quebec was higher at 5.3%, followed by Ontario at 5%.

(Figure 28)

No comparable data was available for US jurisdictions, but some indication of the importance of the high tech sector can be drawn by looking at industry or service sectors which include some high tech as one of their major components. Nevertheless, as Canadian and US Industry Codes don't exactly match, the comparisons illustrated in Figure 29 should be regarded as general observations only. (Figure 29)

Trends (in Constant \$ GDP)

The High Tech Sector has grown rapidly in Canada in the past few years. From 1996 to 1998 Ontario saw the greatest jump with a 24.3% increase in constant GDP \$. Although BC's growth was significant compared to other BC sectors at 11.4%, it trailed all Canadian benchmarked provinces. (Figure 30)

Figure 28

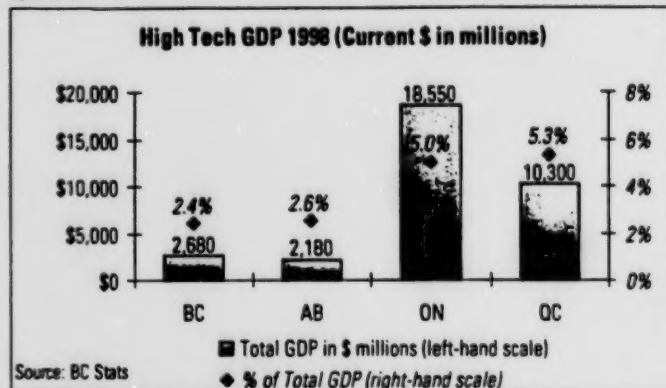


Figure 29

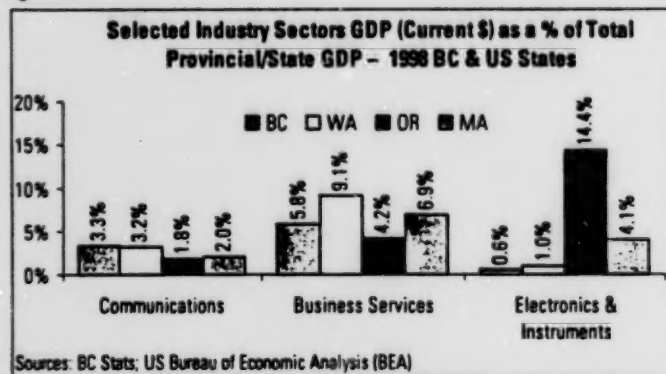
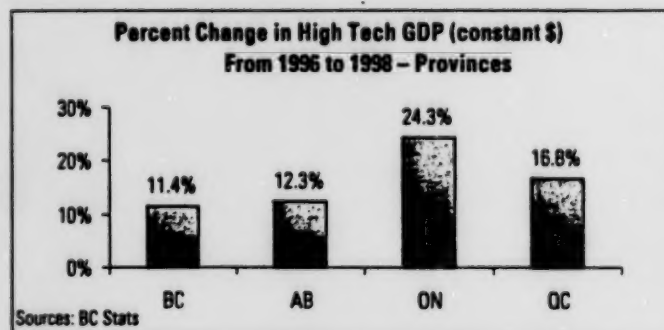


Figure 30



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

Sectoral comparisons

Compared to BC benchmark industry sectors, the high tech sector grew the fastest from 1996 to 1998, increasing from 2.7% to 3% of total provincial GDP. Finance/Insurance & Real Estate (FIRE) grew from 9.6% to 9.8%. Forestry declined during the same period from 5.9% to 5.2%, and Tourism remained constant at 4.8%.

Summary

Although BC high tech GDP has shown a relatively larger increase than other BC sectors over the past few years, it has been trailing all Canadian jurisdictions examined as a proportion to total GDP, and in the growth rate.

2. Employment

Why is this significant?

As an indicator of job creation, employment reflects the relative importance of the high tech sector in BC and its influence on BC's future employment opportunities.

How has BC performed?

High tech employment in BC and Alberta was nearly at the same level in 1999, with BC employing 52,100 people and Alberta 51,400. In BC, this represented 3.5% of total employment, the lowest of the benchmark jurisdictions. Washington and Massachusetts had the highest proportion at close to 10% of total employment. (Figure 32)

In BC high tech sector, Manufacturing accounts for about 20% of high tech employment, and services 80%. (Figure 33).

Figure 31

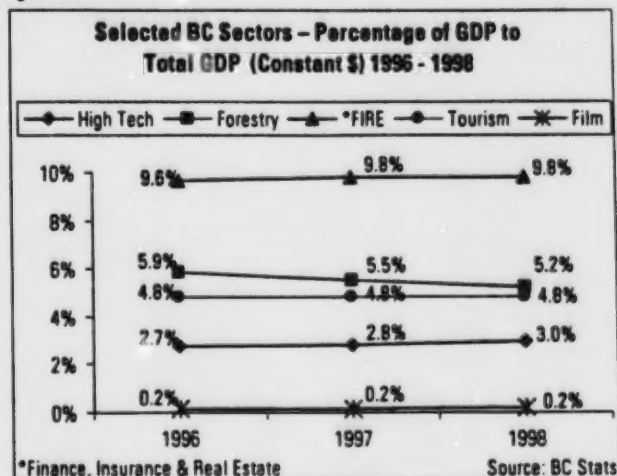


Figure 32

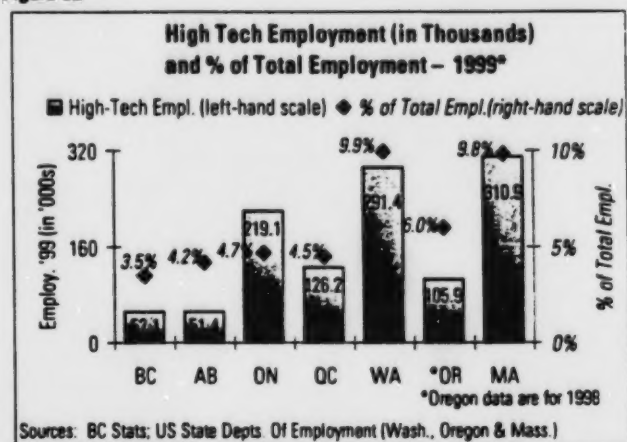
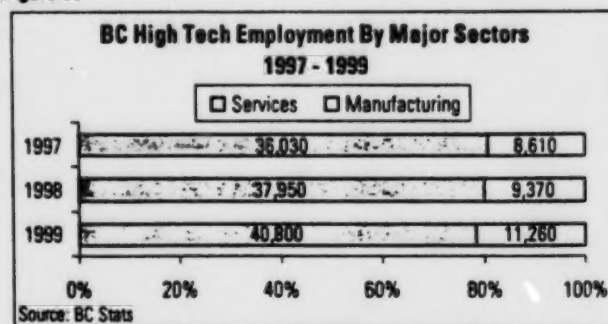


Figure 33



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

Trends

High tech employment in BC has shown continuous growth over the past three years. From 1997 to 1999 employment grew by 16.8%, the second highest increase in benchmark jurisdictions, after Washington which had a marked increase of 17.8%. (Figure 34).

Sectoral comparisons

In comparison to benchmark industry sectors, the high tech sector experienced the highest growth from 1997 to 1999 with a compound increase of 16.2%. The film industry had the second largest increase with a compound rate of 16.0%. (Figure 35).

Summary

While employment growth rate has been ahead of all jurisdictions examined, except Washington State, the percentage of high tech employment as a proportion of total BC employment was the lowest of all jurisdictions in 1999.

3. Wages

Why is this significant?

Wages are an indicator of the value given to its workers who help create wealth through technological innovations. It is also a determinant of standard of living, and of competitiveness in attracting and retaining high tech professionals.

How has BC performed?

BC's high tech wages at an average of \$44,000 per year in 19998 were the second lowest of all jurisdictions examined. Washington State at Cdn \$158,000 had the highest salary. (Figure 36)

Figure 34

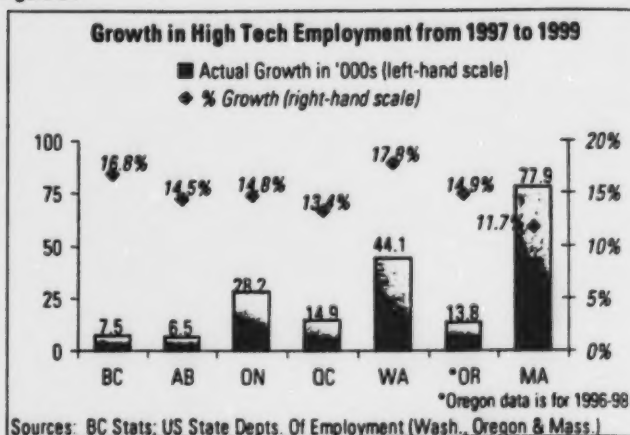


Figure 35

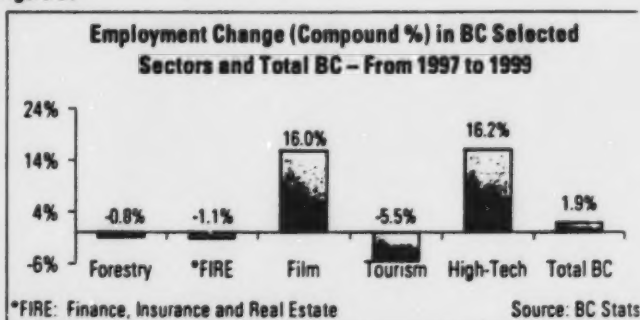
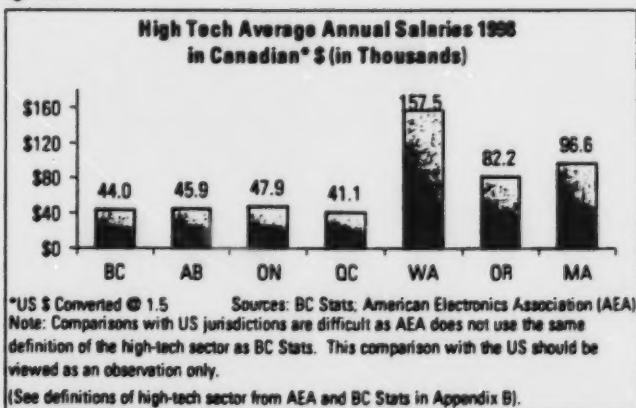


Figure 36



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

In contrast, when compared to BC industrial average wages, high tech wages showed a premium of 37% in 1999. (Figure 37)

Trends^a

Ontario had the highest wage increase from 1997 to 1999 with a compound rate of 9.5%. The second highest increase was in Alberta with a compound rate of 3.4%. BC and Quebec both showed increases below 2% over the period with a compound rate of 1.5% in BC and 1.2% in Quebec. (Figure 38)

Summary

BC high tech wages have generally been below average in comparison to benchmark jurisdictions, and the growth rate has been slower than in the other provinces studied.

Figure 37

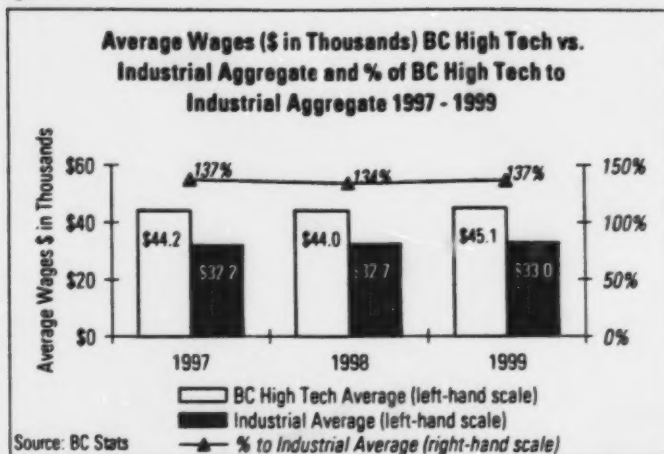
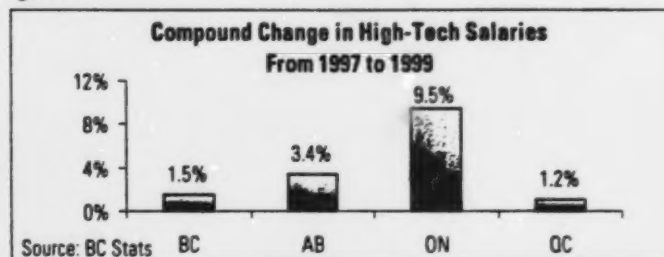


Figure 38



4. Skills Needs/Vacancy Rate

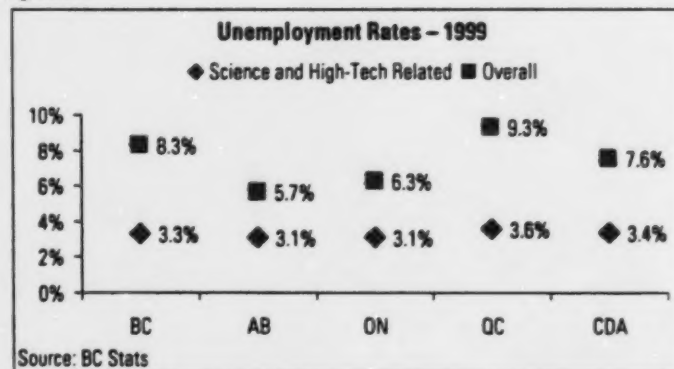
Why is this significant?

The limited availability of skilled workers is an impediment to growth and increases labor costs. This indicator measures the availability of professional and technical talents.

How has BC performed?

Unemployment in science and high tech related positions in 1999 did not show a marked difference from one province to the other, ranging from a low of 3.1% in Alberta and Ontario, a high of 3.6% in Quebec, with BC in the middle with 3.3%. (Fig. 39)

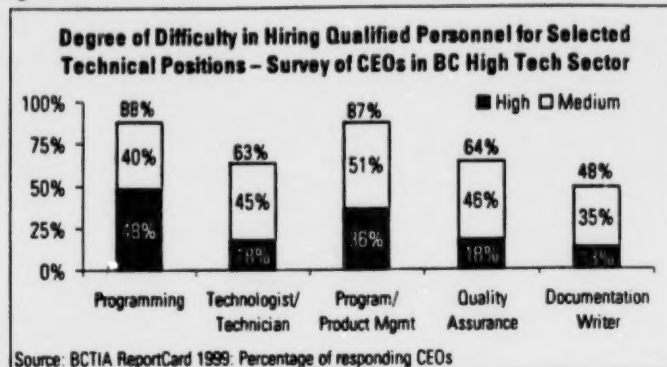
Figure 39



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

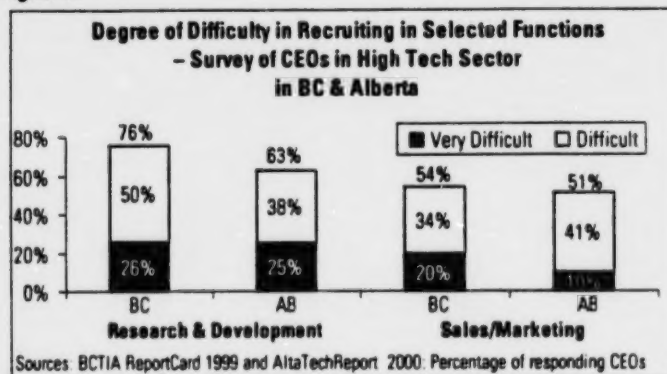
The BCTIA ReportCard 1999 reported on the degree of difficulty in hiring qualified personnel in the BC high tech sector. The positions in Programming and Program/Product Management were considered the most difficult to fill, with 88% and 87% respectively rating it "high or medium". (Figure 40)

Figure 40



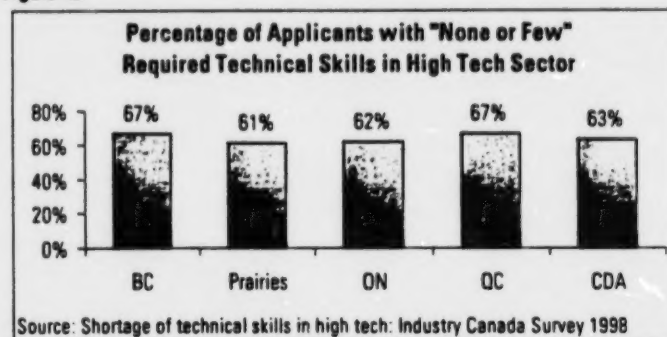
For functions such as R&D and sales and marketing, hiring in the high tech sector is more difficult in BC than in Alberta, according to the BCTIA ReportCard and the AltaTech Report. Positions in R&D were rated as "very difficult or difficult" by 76% in BC and 63% in Alberta. Sales & Marketing positions were rated as "very difficult or difficult" by 54% in BC and 51% in Alberta. (Figure 41)

Figure 41



An Industry Canada Survey conducted in 1998 indicates that in BC 67% of applicants in the high tech sector have "none or few" required skills, the highest percentage with Quebec also at 67%. (Figure 42)

Figure 42



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

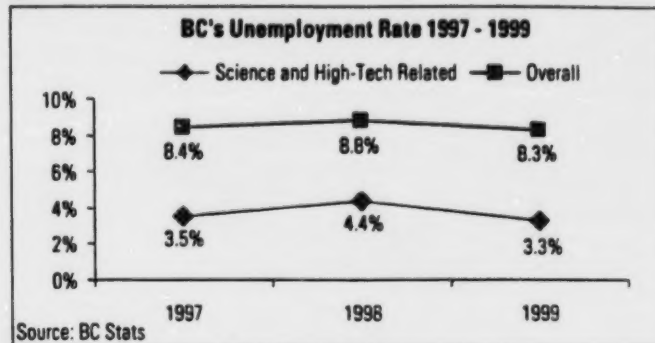
Trends

Unemployment rate in high tech related positions in BC has been consistently lower than the overall BC rate, but has tended to follow the BC unemployment trend, with a high of 4.4% vs. 8.8% in 1999, and a low of 3.3% vs. 8.3% in 1998. (Figure 43)

Summary

BC's unemployment rate in the high tech sector is average when compared to benchmark provinces, but the degree of difficulty in hiring skilled workers is above average, according to surveys where comparable data were available.

Figure 43



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

III Detail Indicators: Analysis of BC's Trends in High Technology

A. Detail Indicators Summary

1. BC Trends in innovation and technology

Exhibit III-1 below presents a brief overview of detail indicators results and illustrates indicators trends in recent years (where data were available). Also, where comparable data were available and comparisons to other jurisdictions were meaningful, ranking averages have been provided. In such cases, the exhibit indicates whether BC has been performing generally above, below or at a level similar to other jurisdictions.

As illustrated in the Exhibit, detail indicators trends have generally been positive. However, some relatively important areas have shown negative trends, such as new business incorporations, and productivity gains.

Comparison with other jurisdictions should be interpreted with caution, as data were not available for all jurisdictions, and in some cases comparisons with only one other jurisdiction were available.

**Exhibit III-1
Detail Indicators Trends Analysis Summary**

Detail Indicators		BC Trends (where available)	Comparisons (where available)
Resource Indicators	Education levels	n/a	Average
	Post secondary enrollment	↑	n/a
	Co-op student placements	↑	n/a
	8th and 12th-grade math and science assessments	n/a	Average
	Foreign direct investment	n/a	Below average
	Telecommunications infrastructure	n/a	Above average
	Internet connectivity	↑	Above average
Innovation Indicators	R&D personnel	n/a	Average
	Federal research laboratories	→	n/a
	R&D intensity	↕	Average
	Joint university/industry R&D	↕	Above average
	Patents and inventions	↕	Average
	Scientific publications	↕	n/a
	Funding for technology transfer centres	↑	n/a
	University research commercialized	↕	Below average
	New business incorporations and survival	↕	n/a
	Venture capital	↑	Average
	Initial public offerings	↑	n/a
	Market value of public high tech firms	↑	n/a

Detail Indicators		BC Trends (where available)	Comparisons (where available)
Business Enablers	Business costs	n/a	Average
	R&D tax credits	n/a	Above average
	Cost of R&D	↓	Below average
	Other provincial incentive and support programs	↑	n/a
Result Indicators	Earnings distribution	↑	n/a
	Incentive compensation	↑	n/a
	Employee turnover	n/a	n/a
	Productivity gains	↓	
	Revenues & profitability	↑	n/a
	High tech trade (exports/imports)	↑	n/a
	Technology diffusion & adoption	n/a	Below average

B. Resource Indicators

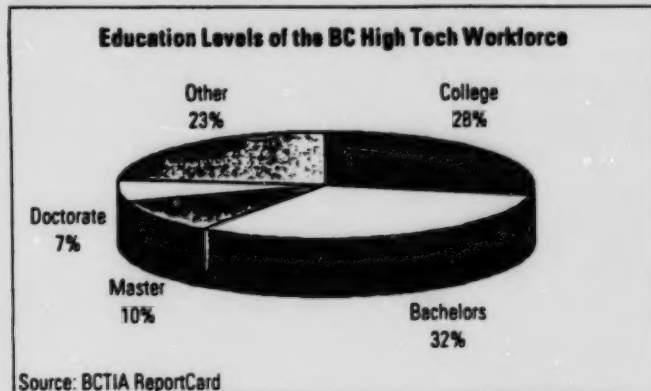
1. Education Levels of the BC High Tech Sector Workforce

The education levels indicate the level of training and skills which employees need to work in the industry. This is important in a sector that requires a highly skilled and specialized workforce.

How has BC performed?

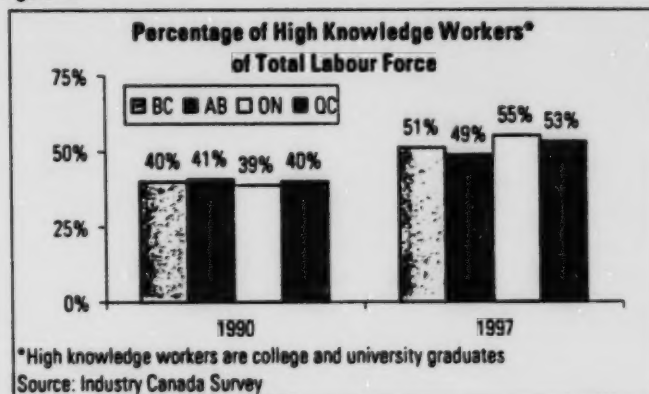
Results of the BCTIA ReportCard 1999 indicate that the BC high tech workforce is highly skilled with more than 75% having received some type of post-secondary education. (Figure 44).

Figure 44



Looking across the country, the number of "high knowledge" workers⁹ in BC grew from 40% to 51% from 1990 to 1997, according to an Industry Canada survey. The trend however, has been slower than in Ontario and Quebec. Ontario increased its high knowledge workforce from 39% to 55% and Quebec from 40% to 53% over the same period. Alberta had a lower increase going from 41% in 1990 to 49% in 1997. (Figure 45)

Figure 45



2. Post Secondary Enrollment in High Tech Disciplines

Enrollment in post-secondary education is an indicator of the capacity and responsiveness of educational institutions to meet the needs of the high tech sector. It also provides an indication of skills available to employers in the future.

How has BC performed?

Enrollment

Enrollment in Engineering, Sciences, and Technology programs has shown a continuous increase over the past three years. (Figure 46)

But the growth rate has decreased in recent years. In 1996 enrollment in sciences had increased 8.5%, but it only went up 4.2% in 1999. A similar slowing trend is notable in technology programs. Enrollment increase was 7.9% in 1996, but only 2.2% in 1998, and 5.1% in 1999. (Figure 47)

Ratio of acceptance to qualified student applications in high tech disciplines

The ratio of admissions to applications in sciences and engineering decreased slightly, both at UBC and at the University of Victoria (UVic) from 1997/98 to 1998/99. (Note: Comparable data for SFU and UNBC were not available.) (Figure 48)

Figure 46

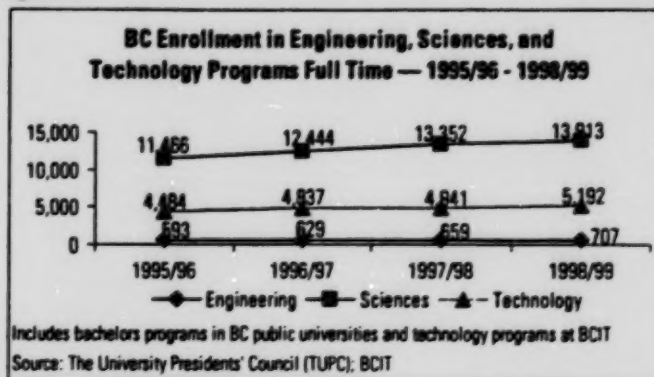


Figure 47

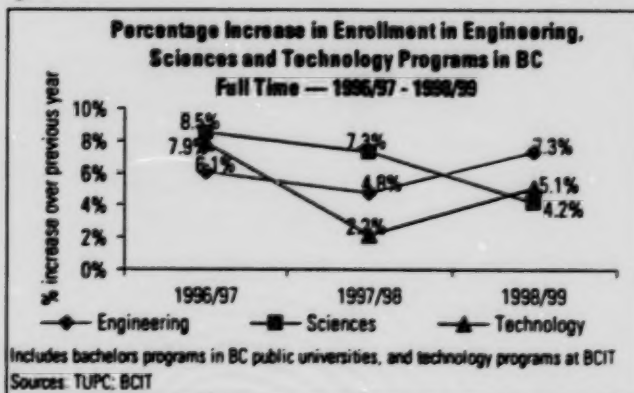
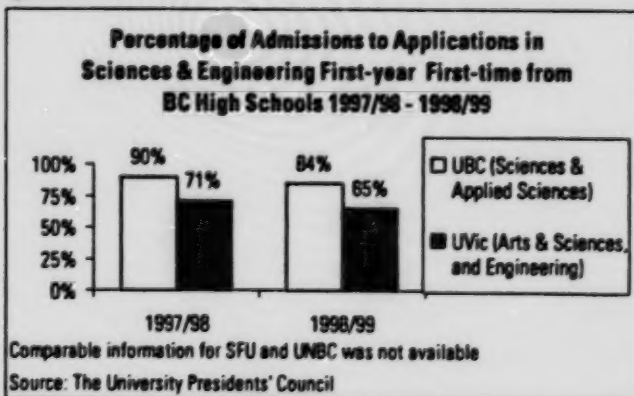


Figure 48



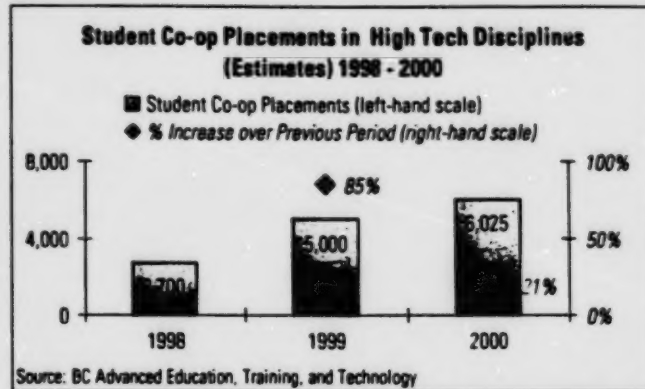
3. Co-op Student Placements

Co-op Student Placements are an indicator of the students' connection to high tech workplaces which is a determinant of the supply of well-trained employees.

How has BC performed?

In the past two years BC has more than doubled the number of co-op placements in the high tech sector, from 2700 in 1998 to 6,015 in 2000. (Figure 49)

Figure 49



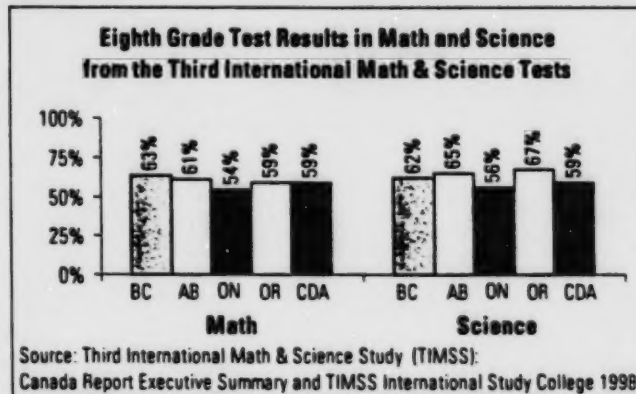
4. Eighth and Twelfth Grade Math and Science Assessments

Math and Science Assessment is an indicator of the quality of the future workforce. Strong skills in science and math are prerequisites for high tech careers.

How has BC performed?

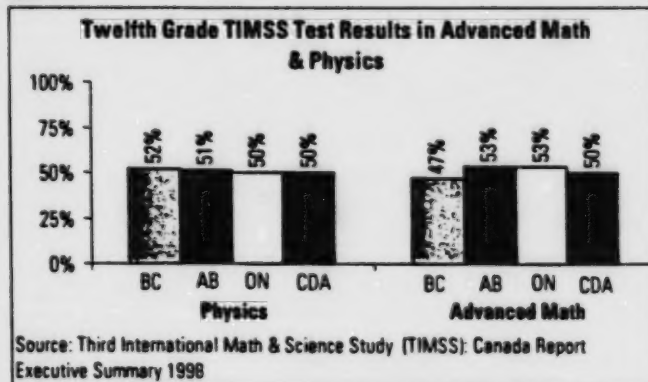
At the Third International Mathematics and Science Study (TIMSS), BC's eighth-grade students performed above average, with a score of 63% in math, the highest score of benchmark jurisdictions. They also scored above average in science tests, with 62%, second to Oregon students who scored 67%. (Figure 50)

Figure 50



At the twelfth grade level, BC's physics students also performed well. They scored 52%, the best score in benchmark provinces. However, they obtained the lowest score in math with 47%. (Figure 51)

Figure 51



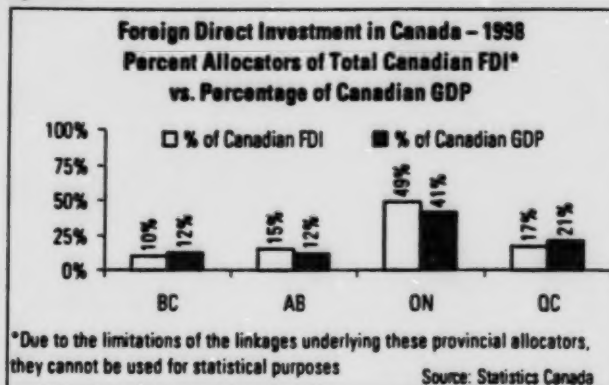
5. Foreign Direct Investments

Foreign Direct Investment measures the province's ability to attract investments by foreign companies. Investments create new jobs and can lead to innovative technologies.

How has BC performed?

Foreign Direct Investment (FDI) provincial allocators calculated by Statistics Canada in 1998 indicate that BC received less FDI than its share of Canadian gross domestic product (GDP), while both Alberta and Ontario received a greater share than their portion of GDP. (Figure 52)

Figure 52



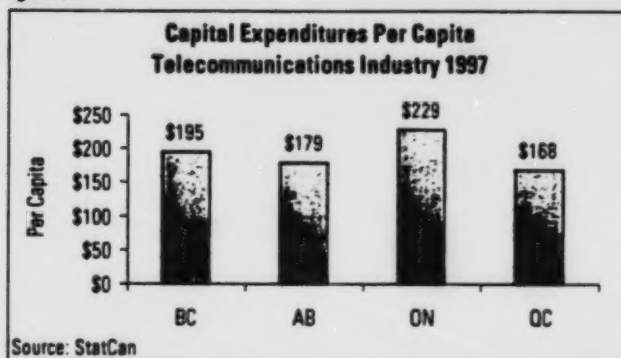
6. Telecommunications Infrastructure

Telecommunications infrastructure spending is an indicator of the ease of flow of knowledge and information, and growth of electronic commerce.

How has BC performed?

Capital expenditures by the telecommunications industry in 1997 were highest in Ontario, on a per capita basis, with \$229 per capita. In BC they represented \$195 per capita. The lowest expenditures were in Quebec with \$168 per capita. (Figure 53)

Figure 53



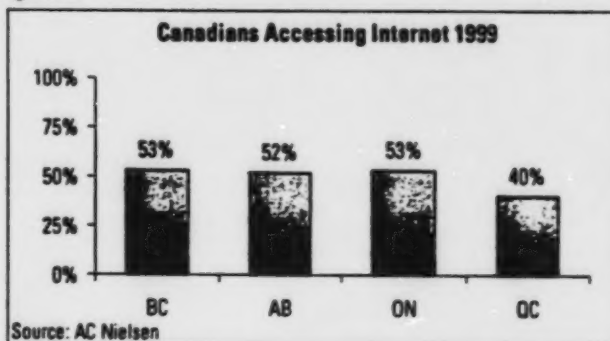
7. Internet Connectivity

Internet connectivity is an indicator of access to knowledge and information and growth of electronic commerce.

How has BC performed?

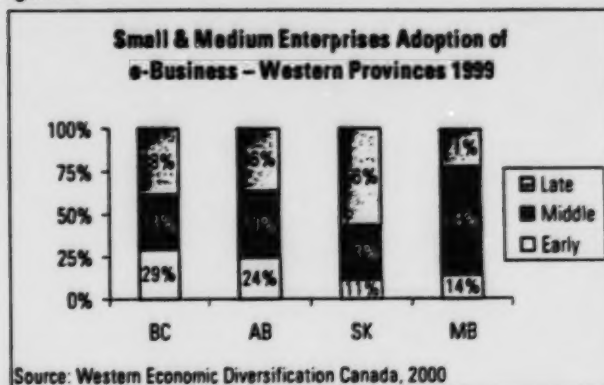
In British Columbia 53% of the population accessed the Internet in 1999, according to an AC Nielsen study. This was the highest number with Ontario, also at 53%. Quebec had a low rate of 40%. (Figure 54)

Figure 54



In businesses, BC small & medium enterprises have been early adopters of e-business, with 29% being early users, according to a Western Economic Diversification Canada study¹⁰. In Alberta, 24% were early adopters. (Figure 55)

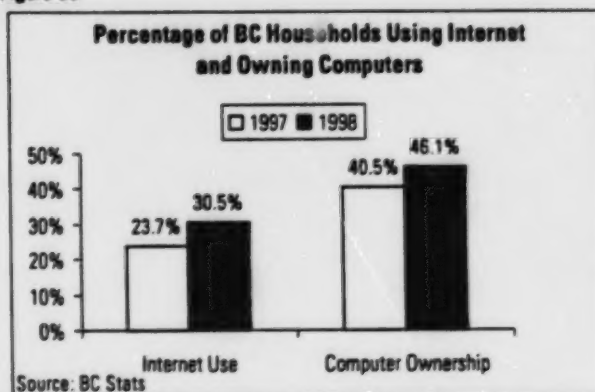
Figure 55



Trends

The percentage of BC households using Internet and owning computers gained 6.8% for internet use and 5.6% for computer ownership from 1997 to 1998. (Figure 56)

Figure 56



C. Innovation Indicators

1. R&D Personnel

R&D Personnel is an indicator of knowledge production as growth is sustained by the people's ability to generate new ideas and translate them into highly valued outputs.

How has BC performed?

BC had a total of 11,240 R&D personnel in 1995 (according to StatsCan census numbers). In BC approximately a third (34%) was working in higher education. In Ontario only a quarter (25%) was in higher education. Alberta had a higher proportion of R&D personnel in higher education with 40%. (Figure 57)

When looking at the number of R&D personnel¹¹ as a percentage of total employment in the high tech sector, with 25% BC stood in the middle of the provinces examined. Ontario and Quebec had the highest proportion with 33%, and Alberta the lowest with 20%. (Figure 58)

In 1995, 57% of R&D personnel in BC were from industry. Higher education employed 34%, and the federal and provincial governments 6% and 3% respectively. (Figure 59)

Figure 57

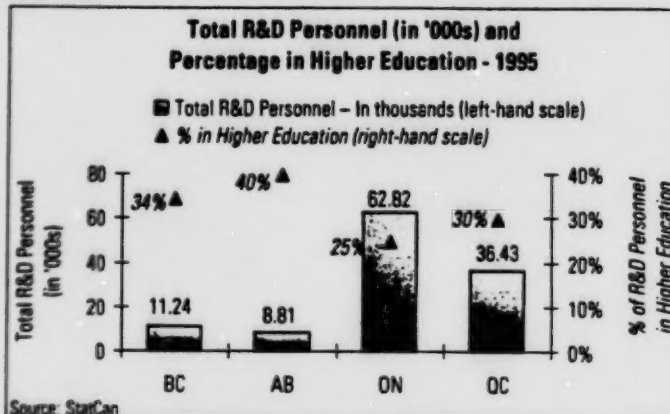


Figure 58

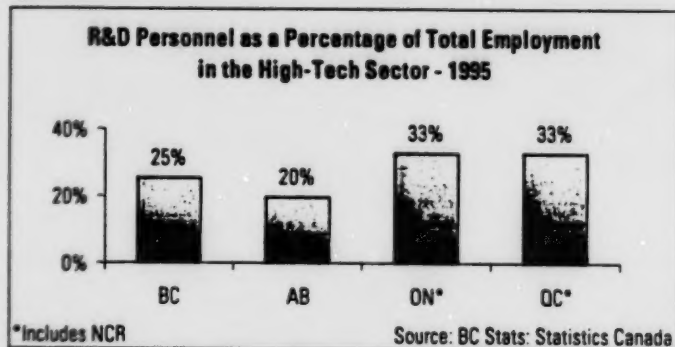
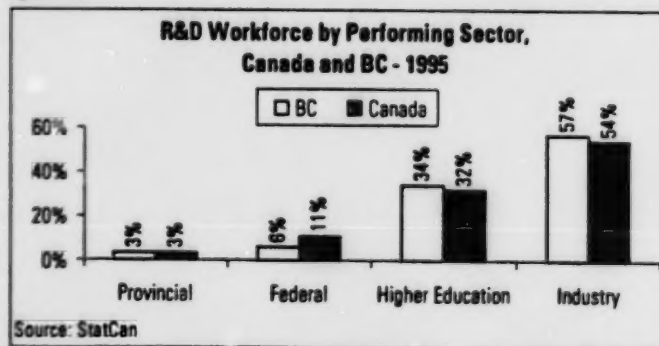


Figure 59



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

2. Federal Research Laboratories

Federal research laboratories expenditures are an indicator of the federal government's support for R&D infrastructure and research.

How has BC performed?

Intramural R&D expenditures of BC federal research establishments showed a substantial increase in 1996 from \$75 to \$146 million. In 1997, expenditures were \$76 million, down to about the same level as in 1995. (Figure 60)

R&D Personnel of BC federal research establishments also increased significantly (20.9%) in 1996, from 554 to 670. The following year, R&D personnel increased from 670 to 701, or 4.6%. (Figure 61)

Figure 60

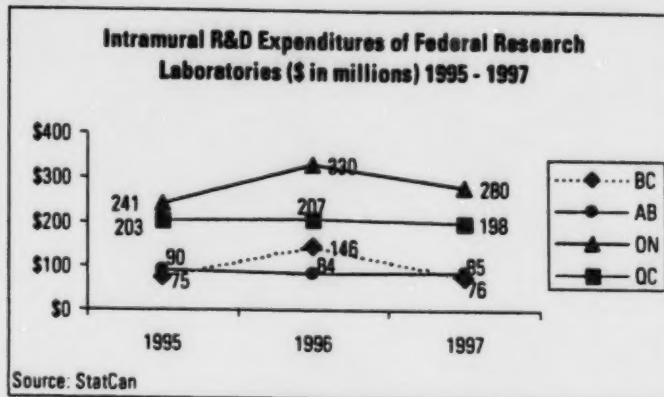


Figure 61



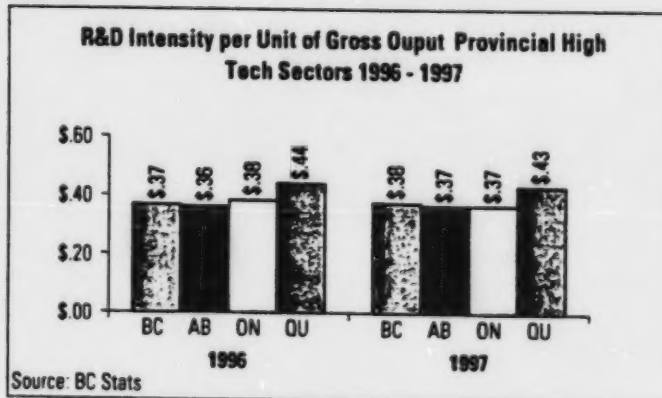
3. R&D Intensity

R&D Intensity is used as a measure of an industry technological sophistication. It is the ratio of R&D expenditures per unit of gross output or value added.

How has BC performed?

R&D intensity doesn't show any significant difference between provinces, except for Quebec with the highest ratio at \$0.43 in 1997, compared to \$0.38 in BC, and \$0.37 in Alberta and Ontario. (Figure 62)

Figure 62



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

4. Joint Research & Development

Joint R&D is an indicator of partnership between academia and industry. Close ties/linkages between sectors accelerate the development and adoption of innovation.

How has BC performed?

Of all benchmark jurisdictions, industry funding share of higher education R&D expenditures was highest in BC with 8.1% in 1997. Alberta ranked second with 8%. Oregon's higher education institutions received 0.9% of their R&D expenditures from industry, the lowest of jurisdictions examined. (Figure 63)

BC's university research (UBC, SFU & UVic) sponsored by non-government sources reached \$65 million in 1999. It decreased from 1997 to 1998 but rebounded in 1999 with an increase of 15.8% over 1998. (Figure 64)

5. Patents and Inventions

Patents and inventions are an indicator of discovery and registry of new ideas and potential commercially important R&D outputs.

How has BC performed?

The number of patent applications in BC was 14.9 per 100,000 population in 1996, the lowest of benchmark provinces. The number of patent awards per 100,000 population was also the lowest (in 1998) with 2.1. Alberta had the highest patents applications with 23.1 per 100,000 of population, while Ontario had the highest patents awards with 4.1 per 100,000 population. (Figure 65)

Figure 63

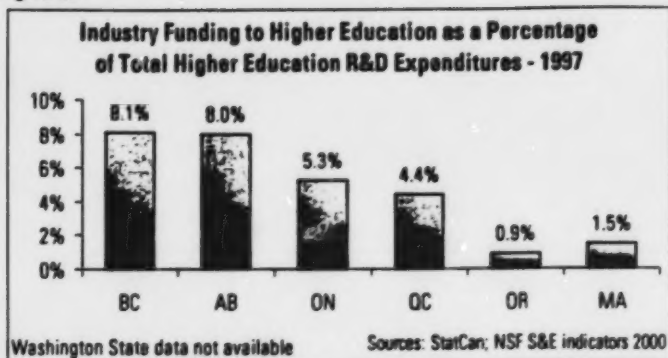


Figure 64

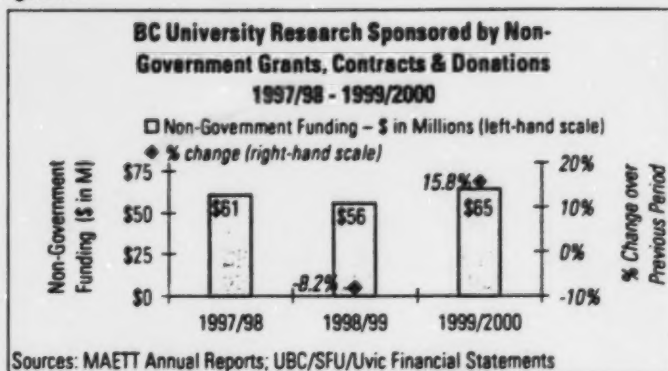
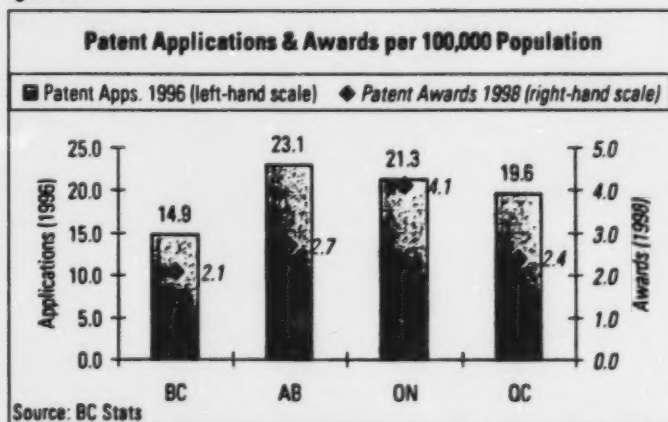


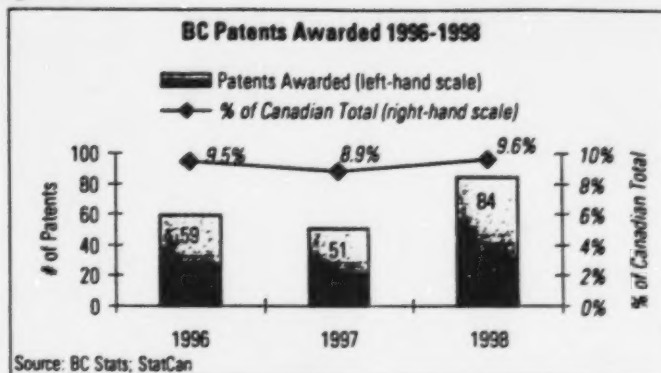
Figure 65



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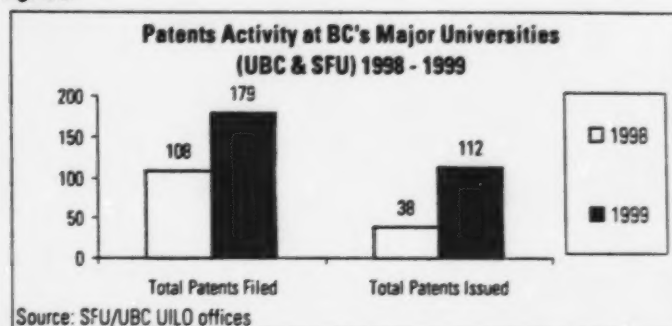
BC was awarded 59 patents in 1996. This number went down to 51 in 1997 but had a rebound in 1998 up to 84. However, as a percentage of Canadian total, 1998 was not much different than previous years. (Figure 66)

Figure 66



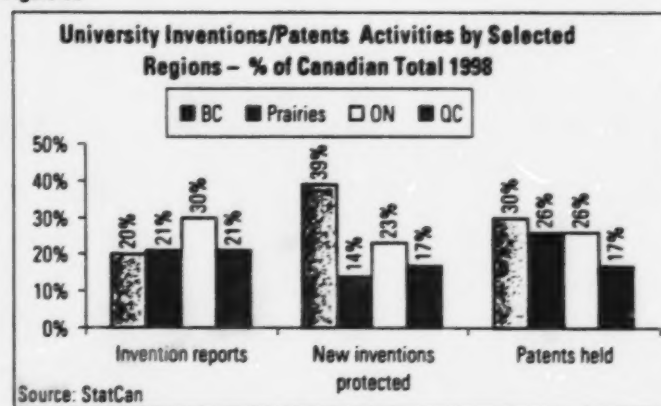
In BC higher education (UBC/SFU), patenting activity showed a significant increase recently, particularly in the number of patents issued, which jumped from 38 to 112 from 1998 to 1999. The number of patents filed also went up from 108 to 179. (Figure 67)

Figure 67



Inventions and patents activities from BC universities represented a large share of Canadian total in 1998. New inventions protected represented 39% of the Canadian total, the highest percentage per province/region. BC's universities also held a large share of patents with 30% of the total. The number of invention disclosures represented 20%. (Figure 68)

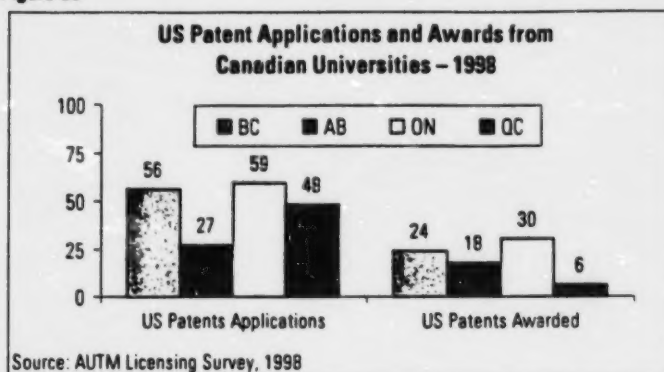
Figure 68



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

US patent applications from, and awards to, BC universities in 1998 were second highest of all Canadian provinces, after Ontario, with 59 US patent applications and 30 awards, according to the Association of University Technology Managers (AUTM) Licensing Survey¹². In 1998, BC universities applied for 56 US patents and were awarded 24, while Alberta universities applied for 27 and were awarded 18. (Figure 69)

Figure 69



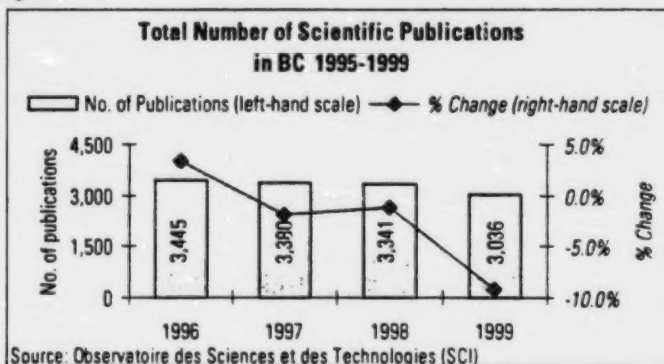
6. Scientific Publications

Scientific publications are an indicator of quantity and quality of knowledge added to the stock of scientific knowledge of the sector, and provide an important contribution to the understanding of the production of science and technology.

How has BC performed?

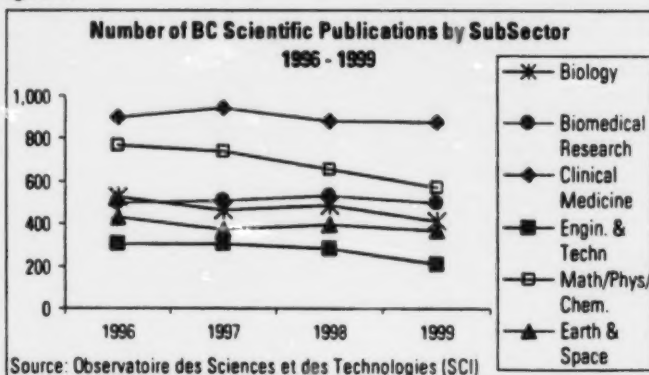
The number of scientific publications in BC peaked in 1996 with 3,445 publications and decreased every year thereafter, with the biggest drop in 1999 (9.1%). (Figure 70)

Figure 70



The number of scientific publications declined in all sectors over the past four years. Biomedical Research showed the smallest decline, with a compound decrease of 8 during the period 1996 to 1999. The biggest drop was in Mathematics/ Physics & Chemistry with a compound decrease of 168 publications or 24%. (Figure 71)

Figure 71



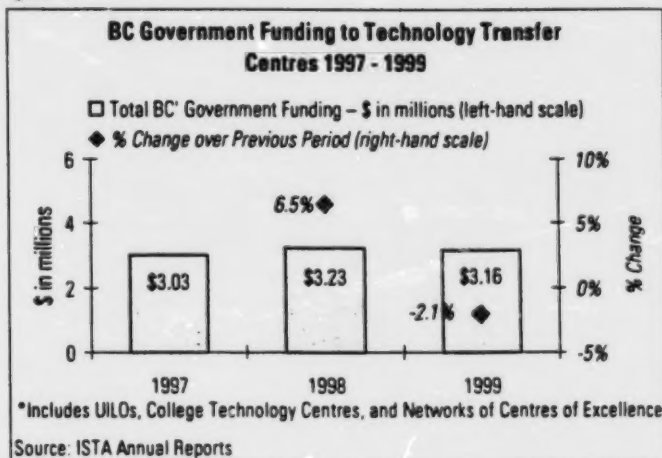
7. BC Government's Funding for Technology Transfer Centres

Government funding for University/Industry Liaison Offices (UILOs), College Technology Centres, and Network Centres of Excellence is an indicator of links between campus researchers and the business community to facilitate commercialization of research results developed by universities and colleges.

How has BC performed?

BC government's funding to technology transfer centres represented \$3.16 million in 1999, a small decrease from the previous year with \$3.23 million, but higher than 1997 at \$3.03 million. (Fig. 72)

Figure 72



8. University Research Commercialized

University revenue from technology licensing is an indicator of the flow of technology to the high tech and other sectors from academic sources, which plays an important role in the innovation process.

How has BC performed?

Technology Licensing

British Columbia's technology licensing income is trailing the other provinces in university technology licensing income. In addition, the average income per license showed a wide difference between BC and Alberta, with BC universities earning \$19,000 per license, in contrast to Alberta's \$71,000 per license. (Figure 73)

UBC earned the largest share of technology licensing income in 1998 and 1999, but SFU had an impressive increase from \$64,000 in 1998 to \$828,000 in 1999. (Figure 74)

Figure 73

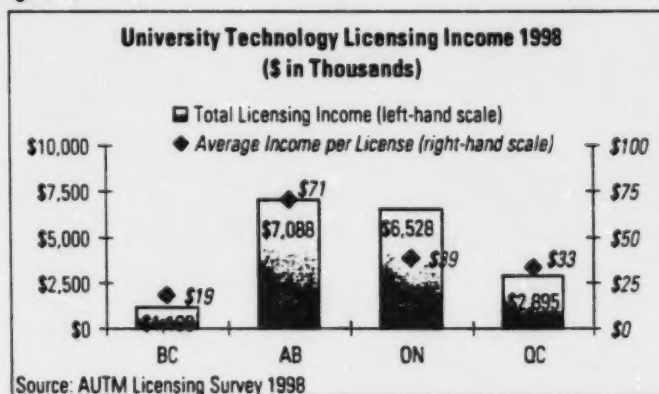
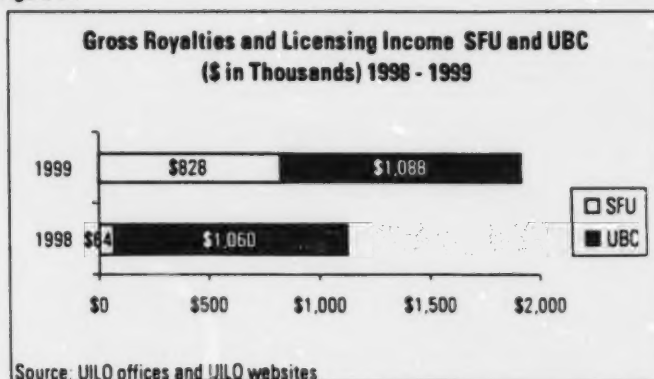


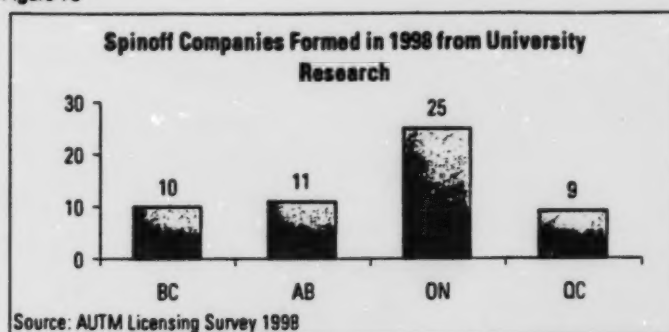
Figure 74



Spinoff Companies

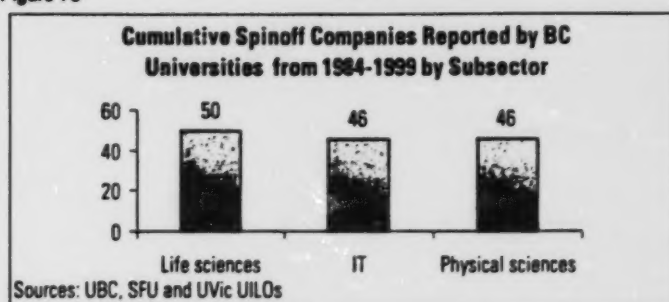
Ten spinoff companies were started from university research in BC in 1998, more than in Quebec with 9, but one less than Alberta with 11. Ontario had the largest number with 25. (Figure 75)

Figure 75



The cumulative number of spinoff companies reported by BC universities from 1984 to 1999 amount to 142. The largest number of companies were in the Life Sciences subsector (50). The other companies were in Information Technology and Physical Sciences, with 46 in each group. (Figure 76)

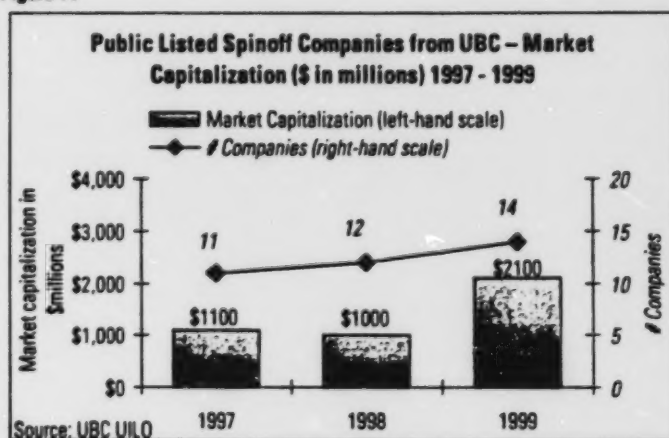
Figure 76



Market Capitalization of Spinoff Companies

The market capitalization of UBC spinoff companies more than doubled from 1998 to 1999 from \$1 billion to \$2.1 billion, although the number of companies only grew from 12 to 14. This indicates an enormous increase in the companies' market value. In contrast, the previous year showed a decrease of \$100 million in the market capitalization while the number of companies grew by one. (Figure 77)

Figure 77



9. New Business Incorporations And Survival

New Businesses are an indicator of business expansion and innovation and reflect the vibrancy of the sector and the entrepreneurial spirit and innovativeness of the firms.

How has BC performed?

Throughout the period 1996 to 1998 the number of new high tech establishments declined in BC. In 1998, 612 new establishments were added in the BC high tech sector. This figure decreased to 511 in 1997 and 506 in 1998. (Figure 78)

By major sectors (during the same period), the high tech services sector experienced higher growth than the high tech manufacturing sector. High Tech services grew by 10.1% in 1997, 9.1% in 1998 and 7.5% in 1999, compared to 7.7%, 1.4% and 4.4% respectively for the high tech manufacturing sector. (Figure 79)

The high tech services sector accounted for 80% of the total number of establishments in 1999, up from 78% in 1997.

The subsectors with the largest numbers of establishments include Computer Services, (representing 31.3% of the total number of establishments), Engineering Services (26.4%), Scientific & Technical Services (18.1%), Medical Health & Labs (4%), Communications & Electronic Equipment (2%). (Figure 80)

In summary, the sector has shown continuous growth, especially the Services sector, but its growth rate has slowed down over the past three years.

Figure 78

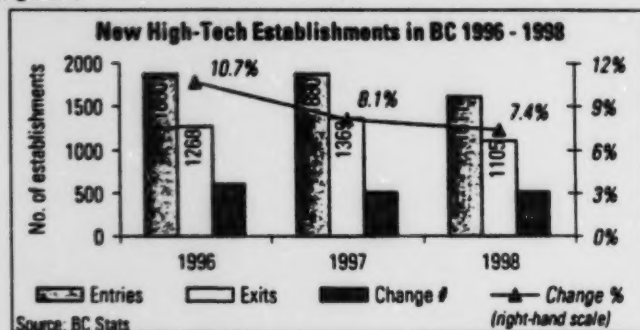


Figure 79

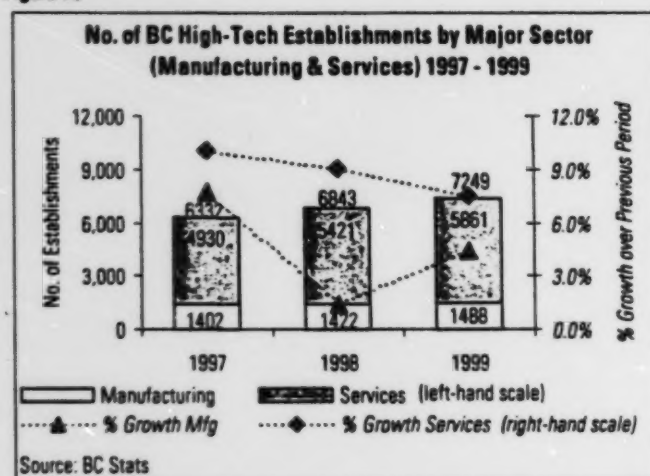
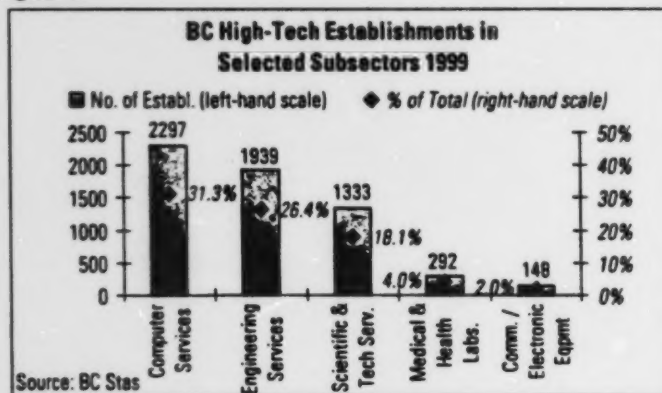


Figure 80



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

10. Venture Capital

Venture Capital is a predictor of start-up and growth of new technology companies, since venture capital is one of the main sources of funding. It tends to reflect confidence in the economy of the province and on start-up companies.

How has BC performed?

In recent years, BC's venture capital investments showed fluctuations (which are common in venture capital markets), going from \$207 million in 1997, down to \$147 million in 1998 and back up to \$250 million in 1999. (Figure 81).

As illustrated by trends in Figure 82 the same fluctuations occurred in other jurisdictions, as the percentage of provincial venture capital vs. Canadian total venture capital has not changed dramatically in recent years. (Fig. 82)

From 1997 to 1999, BC received a larger share of total Canadian venture capital than Alberta. During that period BC's highest share was 11.4% in 1997, while Alberta's highest share was 5.6% in 1998. (Figure 82)

Figure 81

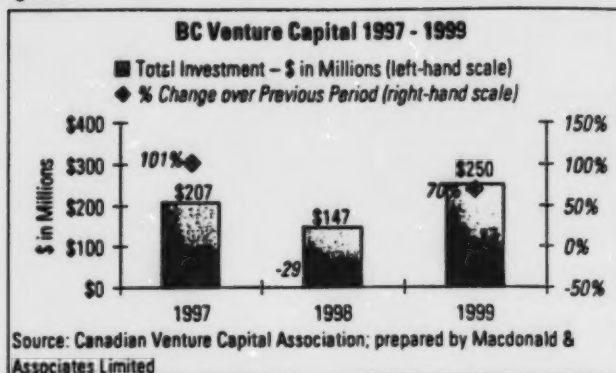
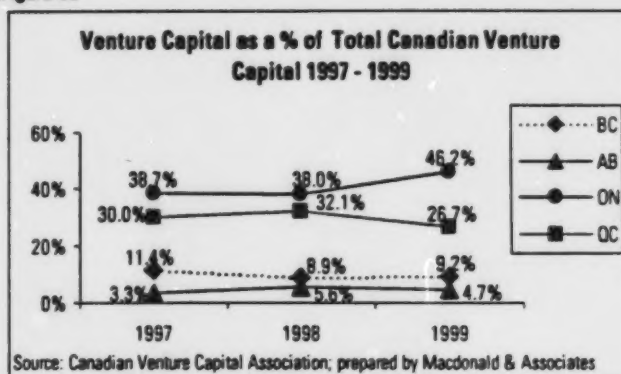


Figure 82



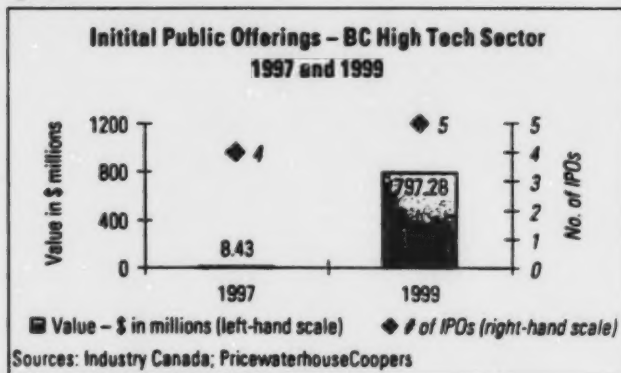
11. Initial Public Offerings (IPOs)

Initial Public Offerings (IPOs) are an indicator of future high-growth companies as significant funds are raised to invest and stimulate growth. They tend to reflect the investors' confidence in a company and in the company's sustainability.

How has BC performed?

Total proceeds of IPOs in the BC high tech sector rose from \$8.43 to \$797.3 million from 1997 to 1999. Yet the number of IPOs only increased by one, from 4 to 5. This reflects a spectacular increase in the average IPO value. (Figure 83)

Figure 83



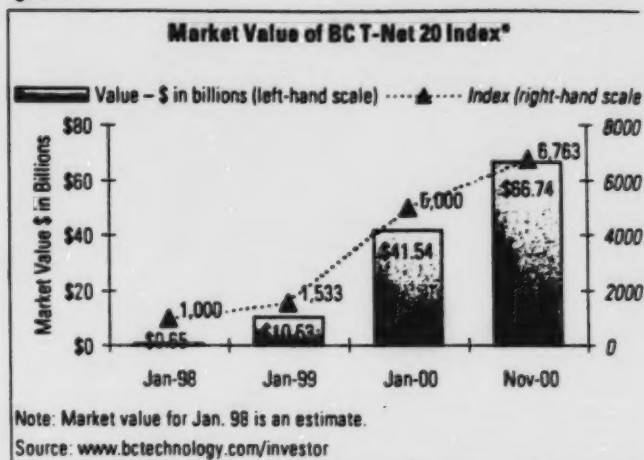
12. Market Value of Public High tech Sector Firms

The Market Value of public high tech sector firms is an indicator of the firms' market attractiveness and the innovation they market – although other factors may have greater impact on a short-term basis. Market Value may reflect the growth orientation of the sector.

How has BC performed?

The T-Net 20 Index followed global high tech market trends in 1999 and rose from 1533 in January 1999 to 5000 in January 2000 (226% change). The market value also increased significantly, nearly quadrupling from \$10.53 billion to \$41.54 billion. In 2000, the T-Net index slowed down, but still rose from 5000 to 6763 from January to November 2000 (35% increase). (Figure 84)

Figure 84



*T-Net 20 is an index of the 20 largest publicly-traded technology companies in BC ranked by market capitalization. Only technology companies with headquarters in BC and who trade on recognized stock exchanges are included in the index.

D. Business Enablers

1. Business Costs

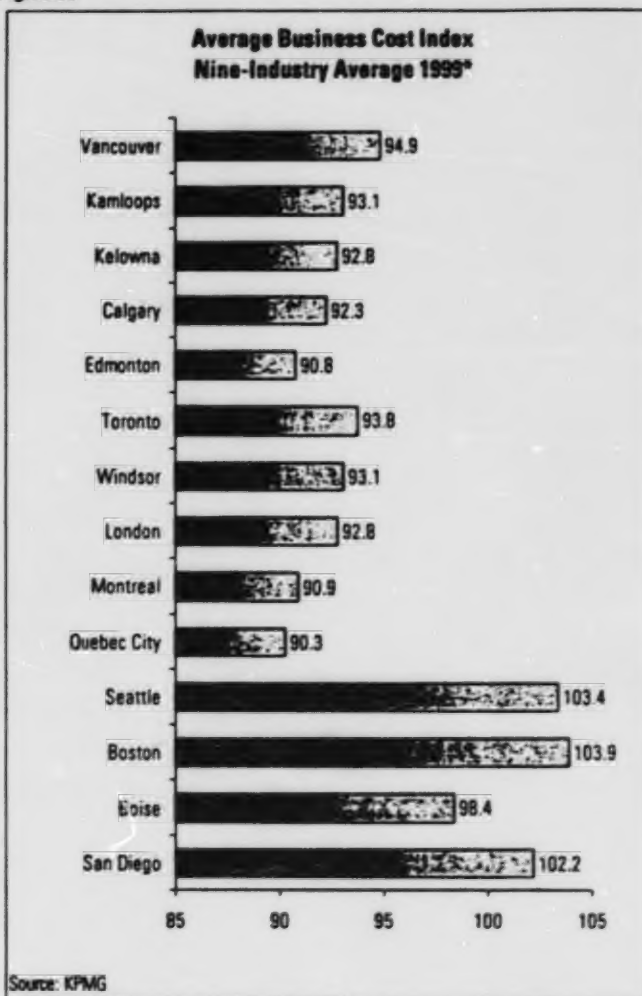
Costs of doing business are an indicator of the competitiveness of the province relative to other locations.

The total average business cost index is based on labour costs, transportation costs, electricity costs, telecommunications costs, interest charges, depreciation charges, property taxes, transaction and income taxes. The nine-industry average includes electronics, food processing, medical devices, metal fabrication, pharmaceutical, plastics products, telecom equipment, packaged software, and advanced software.

How has BC performed?

The three BC cities surveyed in the KPMG study generally have higher business costs than cities of similar size in the benchmark provinces. However, when compared to surveyed cities in the US, costs in BC are very competitive, with an index of 94.9 for Vancouver vs. 103.4 for Seattle. (Figure 85)

Figure 85



*The nine-industry average includes electronics, food processing, medical devices, metal fabrication, pharmaceutical, plastics products, telecom equipment, packaged software, and advanced software.

Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

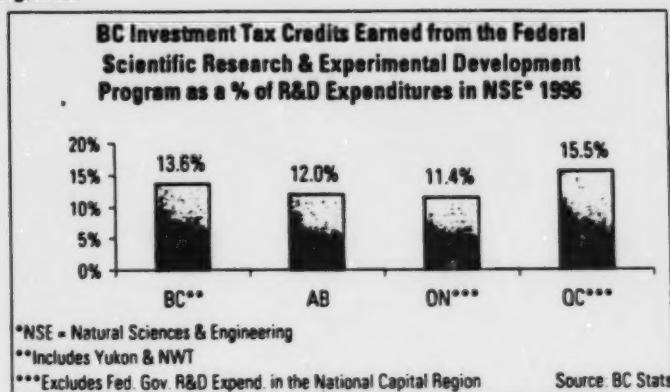
2. R&D Tax Credits

R&D Tax Credits are an indicator of R&D cost. They reduce the cost of R&D and encourage R&D investments which produce innovations.

How has BC performed?

When comparing investment tax credits earned from the federal scientific research & experimental development program in 1996 (the most recent year for which data were available), it is noted that BC received the equivalent of 13.6% of R&D expenditures in NSE, second to Quebec with 15.5%. (Figure 86)

Figure 86



3. Cost of R&D

R&D costs determine the attractiveness of R&D investments to the province and reflect government willingness to support R&D investment.

How has British Columbia performed?

With the 1999 introduction of the R&D tax incentives, BC's cost of R&D for large manufacturing firms has been reduced from \$0.51 in 1996 to \$0.45 in 1999, representing the lowest after-tax cost of \$1 R&D expenditures in 1999. (Figure 87)

For small manufacturing companies, Ontario was the lowest at \$0.46, followed by Quebec and BC at \$0.47 each. (Figure 88)

Figure 87

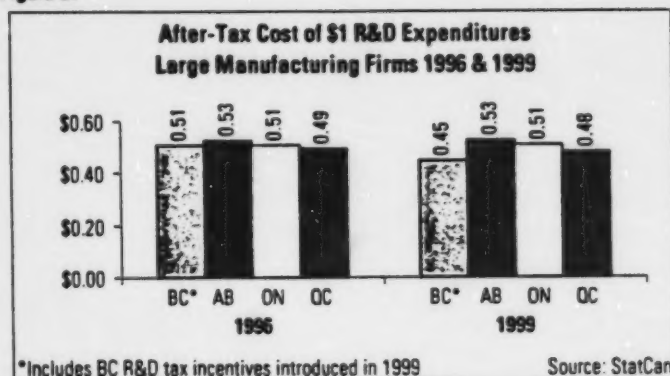
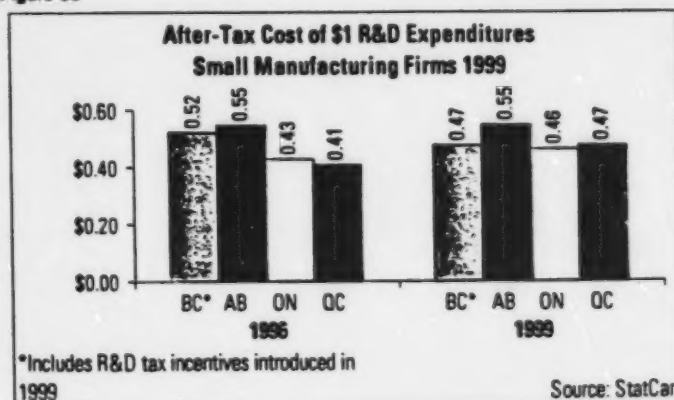


Figure 88



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

4. Other Provincial Incentive and Support Programs

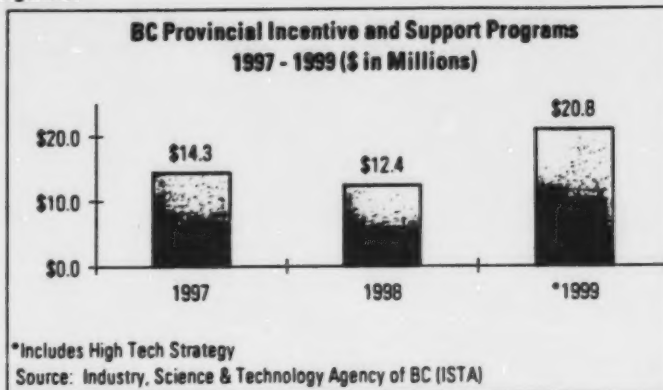
Incentive and support programs are an indicator of favourable business and innovation climate.

BC provincial government expenditures on high tech support and incentive programs include funding to the Biotech Alliance, BC Advanced Systems, Science Council of BC, Vancouver Island Technology Centre, BC High Tech Strategy, Regional Initiatives (such as Market Assessment of Research and Technology, and Technology Assistance Program), and other technology-related initiatives.

How has British Columbia performed?

BC's funding support to the high tech industry has jumped from \$12.4 to \$20.8 million from 1998 to 1999, reflecting the major increase in funds allocated to high tech initiatives, including the 1999 BC High Tech Strategy. (Figure 89)

Figure 89



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

E. Results Indicators

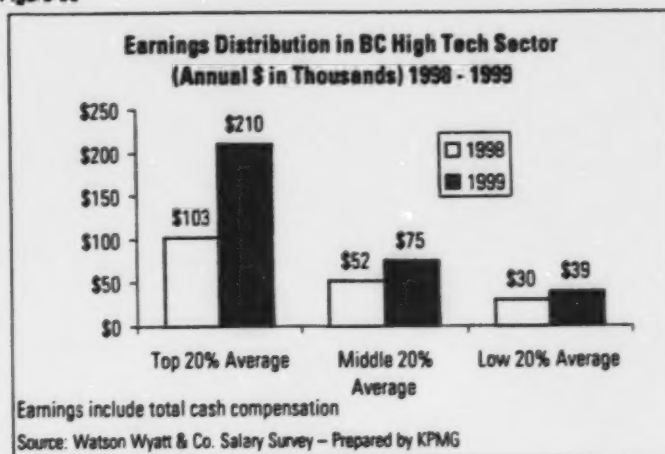
1. Earnings Distribution

Earnings distribution is an indicator of how wealth is shared by all workers in the sector and whether or not better standards of living are enjoyed by a broad base of workers.

How has BC performed?

The Watson Wyatt 2000 salary survey indicates that the average annual earnings (total cash compensation) of high tech workers increased significantly between 1998 and 1999. High tech workers in the top 20% of the compensation scale saw their average annual cash earnings more than double, from \$103,000 to \$210,000. Average cash compensation of the 20% in the middle of the compensation scale went from \$52,000 to \$75,000, and of the low 20% from \$30,000 to \$39,000 per year. (Figure 90)

Figure 90



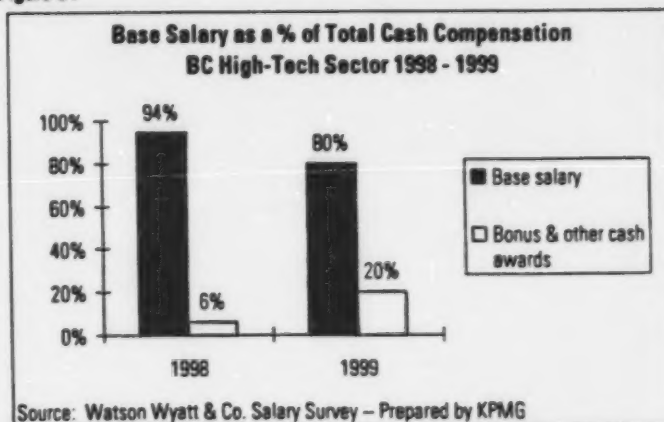
2. Incentive Compensation

Bonuses and other compensation rewards are an indicator of companies' competitiveness in attracting and retaining high tech professionals.

How has BC performed?

In 1999 base salary in the BC high tech sector represented a smaller portion of total cash compensation than in 1998, according to the Watson Wyatt 2000 salary survey. In 1998, base salary accounted for 94% of total cash compensation, with bonuses and other cash rewards amounting to 6%. In 1999, base salary represented 80% and cash rewards 20% of total cash compensation. (Figure 91)

Figure 91



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

3. Employee Turnover

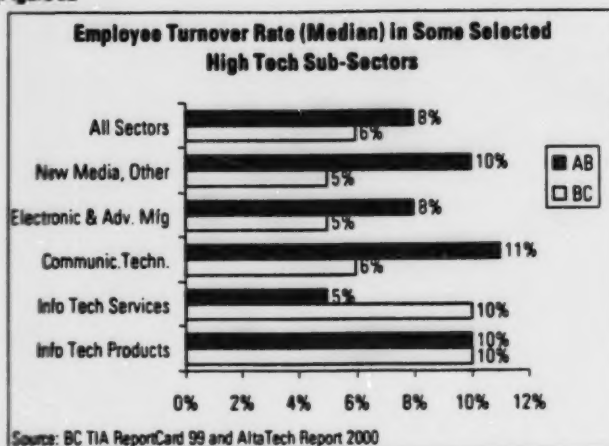
Employee turnover is an indicator of stability. Lower employee turnover is a competitive advantage which helps make a location attractive.

How has BC performed?

Survey results from BCTIA ReportCard and AltaTech Report indicate that employee turnover is generally higher in Alberta than in BC, with an overall rate of 8% in Alberta and 6% in BC.

The highest turnover rates in BC are in the Information Technology with 10%, in both the services and products sub-sectors. (Figure 92)

Figure 92



4. Productivity Gains

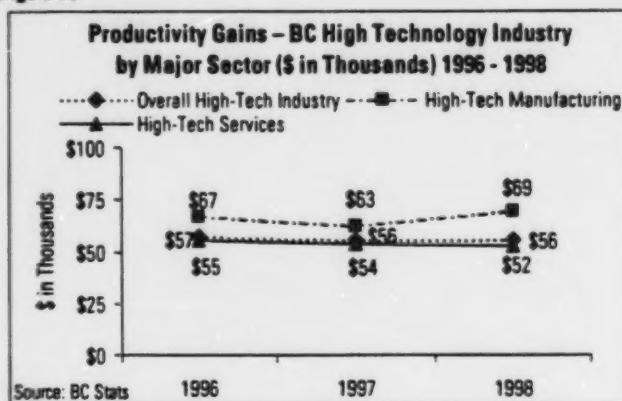
Productivity gains are an indicator that individual workers are producing more and that capital is being used more efficiently. They also reflect the sector competitiveness.

Productivity is the ratio of high tech GDP to high tech employment.

How has BC performed?

Productivity gains in the high tech sector had some fluctuations between 1996 and 1998, but the overall trend actually declined slightly from \$57,000 in 1996 to \$56,000 in 1997 and remained at that level in 1998. (Figure 93)

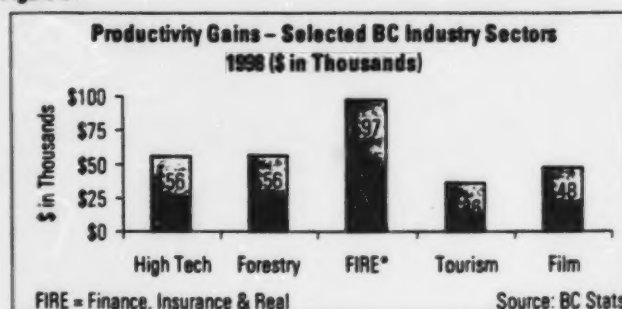
Figure 93



High tech manufacturing showed some gains in 1998 rising from \$63,000 to \$69,000, after a decline from \$67,000 to \$63,000 in 1997. The services sector declined from \$55,000 in 1996 to \$54,000 in 1997, and \$52,000 in 1998. (Figure 93)

High tech was at the same level as Forestry in 1998 with \$56,000. Finance/ Insurance & Real Estate (FIRE) had the highest performance at \$97,000. (Figure 94)

Figure 94



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

5. Revenue & Profitability

Revenue and profitability is an indicator of industry growth and size and reflects the market success of innovations embodied in products and services.

How has BC performed?

Revenues

High tech revenues in BC increased from \$5 billion to \$5.7 billion from 1996 to 1998. This represents a 14% increase over the two-year period.

High tech manufacturing revenues grew from \$1.5 billion to \$1.9 (26%) and high tech services from \$3.5 to \$3.8 billion (9%). (Figure 95)

Profitability

BCTIA ReportCard indicates that generally it takes less time for large firms than smaller firms to become profitable. Within four years, 69% of firms with more than 20 employees become profitable, while only 59% of high tech firms with 1-19 employees become profitable within four years. (Figure 96)

Overall, 50% of firms are profitable within two years, but it takes eight more years for the next 45% to become profitable. This represents a rate of 95% profitability within 10 years. (Figure 97)

Figure 95

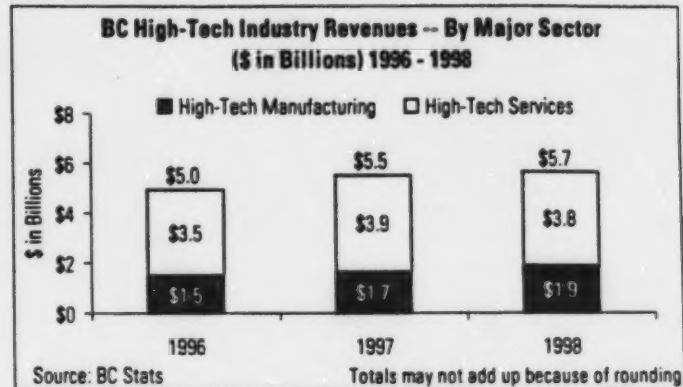


Figure 96

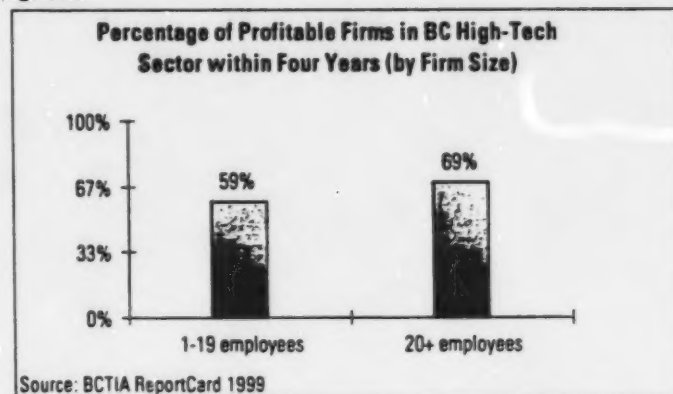
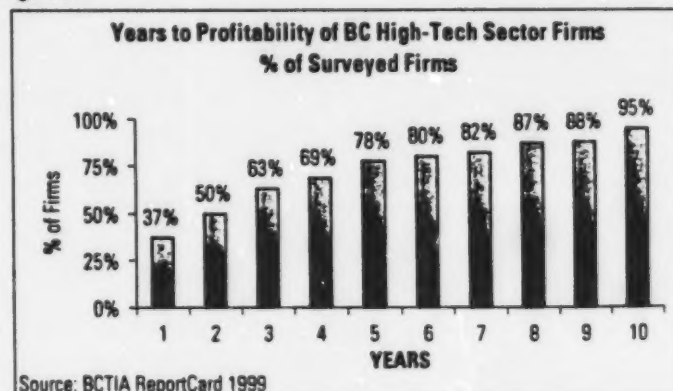


Figure 97



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

6. High Tech Trade

High tech trade (exports/imports) is an indicator of the flow of technology embodied in goods and services. High tech exports also indicate global competitiveness and reflect the success of innovations embodied in export products and services.

How has BC performed?

High tech trade

BC high tech exports showed a steady increase between 1997 and 1999, going from \$609.7 million in 1997 to \$816.4 million in 1999. Imports also grew from \$2,427.6 million from 1997 to \$3,039.3 million from 1997 to 1999. (Figure 98)

High tech export markets

From 1997 to 1999, the US market share of BC high tech exports increased from 69.7% to 83.3%, while the Asia/Pacific market share declined from 19.3% to 8.6% over the same period. This reflects a very high dependence on the US market for high tech exports. (Figure 99)

Computer & telecommunications have been the largest export commodity over the past three years, although their market share has declined from 46% to 28% from 1997 to 1999. Other commodities have captured a larger share of exports. For example, Aerospace/Nuclear increased its share from 10% to 16%; Material Design from 2% to 12%; and Opto-Electronics from 6% to 11%. (Figure 100)

Figure 98

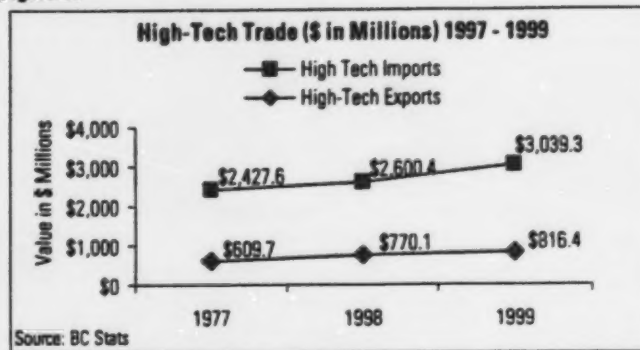


Figure 99

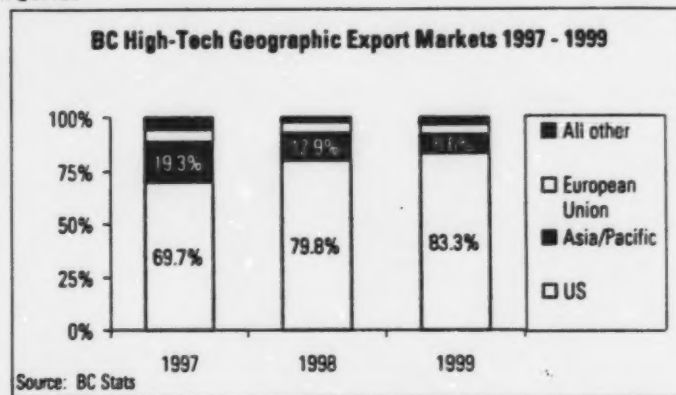
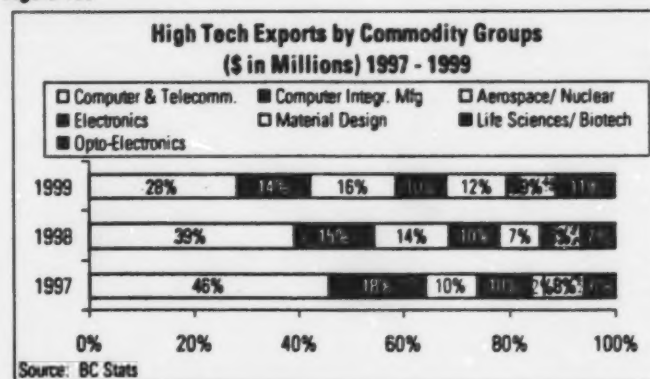


Figure 100



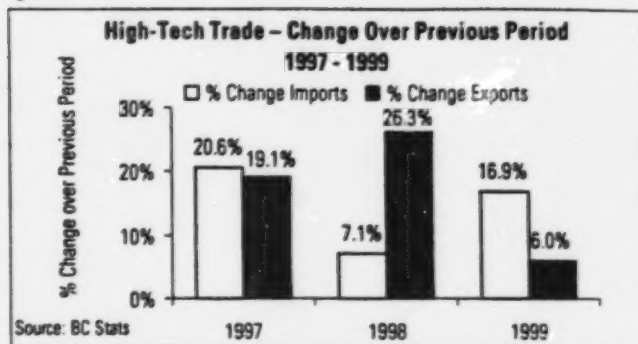
Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

Trends

BC high tech exports grew 19.1% in 1997 and 26.3% the following year. However, the increasing trend slowed down to 6% in 1999. (Figure 101)

High tech imports also showed significant increases with a 20.6% growth in 1997. The following year, the increase slowed down to 7.1% and moved up to 16.9% in 1999. (Figure 101)

Figure 101



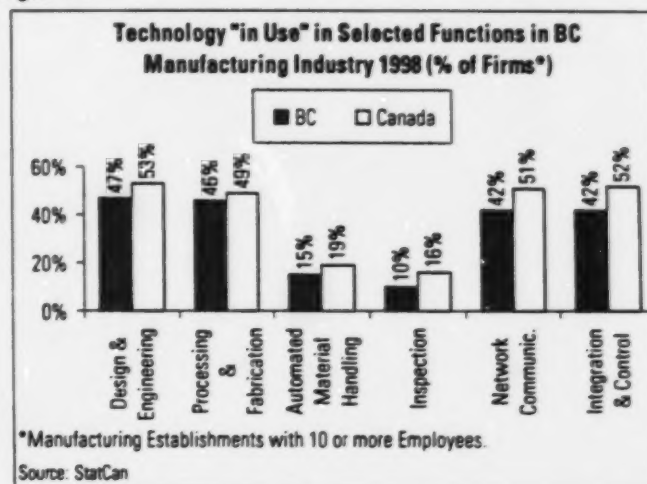
7. Technology Diffusion & Adoption

Technology diffusion is an indicator of uptake of high tech solutions which help enhance productivity of other industries outside the high tech sector. Technology adoption also reflects the level of confidence in the technology.

How has BC performed?

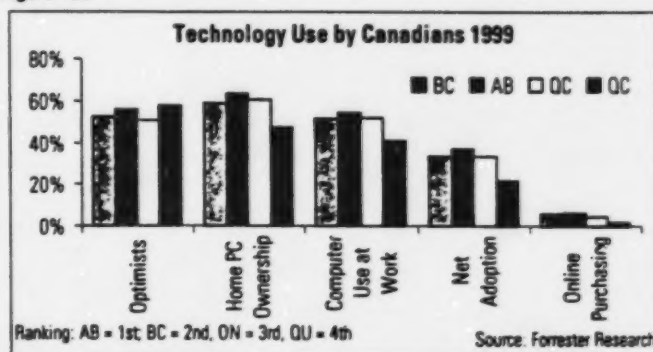
Manufacturing firms in BC are slower than in the rest of Canada in adopting technology in their manufacturing plants. According to a Statistics Canada survey conducted in 1998 on technology adoption in Canadian manufacturing, technology use by BC manufacturing firms lags behind the Canadian average. (Figure 102)

Figure 102



In a survey released by Forrester Research in 1999, British Columbia was rated second of all Canadian provinces in the "technology use by Canadians". Alberta was ranked first in all areas (technology optimists¹³, home computer ownership, computer use at work, internet adoption and online purchasing). (Figure 103)

Figure 103



Caution: Secondary data taken from different sources may not be strictly comparable. See Appendices for further information on primary data sources.

IV Conclusions

While the primary purpose of this study is to develop a set of high tech sector performance measurement benchmarks, KPMG has also been asked to provide general conclusions as appropriate. These conclusions represent the view of KPMG, and are not necessarily those of the Science Council of BC or the Performance Measurement Committee.

A. Current State — Relative to BC High Tech Strategy

The current state of the BC high tech sector, in the context of the Province's four High Tech Strategy goals, is assessed as follows:

- **Goal #1 – Make BC a Place of Choice.** As illustrated in Exhibit IV-1, high tech GDP, employment, and wages show rising trends in BC in recent years, while tax rate trends have generally remained flat. On the other hand, the relative significance of BC's high tech industry tends to be lower than the other US and Canadian jurisdictions studied.
- **Goal #2 – Develop and Attract Talent.** BC's post-secondary education spending is above the Canadian average, although recent trends have been flat. Wages, primary/secondary education expenditures, and skills needs are at about the Canadian average, but are generally below US levels. BC's ability to develop and attract talent appears similar to other major provinces, but below the US jurisdictions examined.
- **Goal #3 - Expand Research and Development.** Recent trends in BC have been flat, and BC's statistics do not compare well with the other Canadian and US jurisdictions examined. While R&D tax incentives were introduced in 1999 in British Columbia, the impact of these incentives would not yet be reflected in R&D statistics.
- **Goal #4 – Market and Promote BC.** The linkages between the headline indicators examined and this goal tend to be indirect. However, for two of the detail indicators we have identified some data which provide some insight into BC's performance. Compared to benchmark provinces, BC is average in terms of Venture Capital and below average in terms of Foreign Direct Investment.

Exhibit IV-1
Achievement of BC High Tech Strategy Goals

Goals	BC Trends ^(a)	Comparison ^(b) to	
		Provinces	US States
No. 1: Make BC a Place of Choice			
• High Tech GDP (as a % of total GDP)	↑	Below average	n/a ^(c)
• Employment	↑	Below average	Below average
• Wages Earned ^(d)	↑	Average	Below average
• Tax rates:			
- Corporate	→	Less favourable	Less favourable
- Overall personal	→	Average	Less favourable
No. 2: Develop and attract talent			
• Spending on Education:			
- Primary/Secondary (per student)	↑	Average	Below average
- Post-secondary (per capita)	→	Above average	Average
• Science & engineering graduates (# per capita)	↑	Below average	Below average
• Wages Earned ^(d)	↑	Average	Below average
• Skills Needs	→	Average	n/a
No. 3: Expand research & development			
• R&D Expenditures (as a % of total GDP)	→	Below average	Below average
No. 4: Market and promote BC			
• Venture Capital ^(e)	↑	Average	n/a
• Foreign Direct Investment ^(e)	n/a	Below average	n/a

Notes: ^(a)Trends: Generally upwards: ↑; Little or no significant change: →; Generally downwards: ↓
^(b)Comparisons to Provinces and US States are for the latest year(s) for which data were available.
^(c)n/a = trends or comparisons were not available.
^(d)Wages reflect performance of goals no. 1 and no. 2.
^(e)Indirect measures

B. Current State — Relative to the Performance Measures Framework

1. Headline Indicators

The key study findings for the selected nine headline indicators are illustrated in Exhibit IV-2, and are described as follows:

- **Resource Indicators:** BC has experienced increasing numbers of Science and Engineering graduates during the late 1990s, but its overall levels are still generally lower than in the other jurisdictions examined. Primary/secondary education spending in BC

has been increasing and is similar to the Canadian Provinces examined, but below the US jurisdictions. Post-secondary educational spending trends have been fairly steady, with expenditures tending to be higher in BC than in other Provinces, and similar to the US jurisdictions examined. While limited statistics on migration of high tech workers are available, the evidence suggests that BC's rates of inward and outward migration of workers are both above the average of the other provinces examined.

- **Innovation Indicators:** R&D expenditures trends have been flat in BC during the late 1990s. BC's R&D expenditure levels tend to be lower than in the other jurisdictions examined.
- **Business Enablers:** Corporate tax rates have been fairly steady in BC in recent years, at levels which are higher than those of the other jurisdictions examined. Personal tax rates have generally been similar to other benchmark provinces, but above US jurisdictions examined. Personal tax rates have trended downwards over the past few years, but at a lower rate than most of the other jurisdictions studied.
- **Results Indicators:** While high tech GDP has been increasing in BC, the high tech sector's portion of GDP tends to be lower in BC than in the three other provinces examined. (Comparable data are not available for the US jurisdictions). High tech employment has also grown, yet its relative economic significance also tends to be lower than for the Canadian and US benchmark jurisdictions. Wages have increased and are in line with other Canadian jurisdictions, but are considerably below US jurisdictions. Information regarding skills needs and vacancy rates is limited, but the available evidence suggests that BC's situation is similar to that of the other provinces.

Exhibit IV-2 Headline Indicators

Headline Indicators	BC Trends ^(a)	Comparison ^(b) to	
		Provinces	US States
Resource Indicators:			
• Science & engineering graduates (# per capita)	↑	Below average	Below average
• Education spending:			
- Primary/secondary (per student)	↑	Average	Below average
- Post-secondary (per capita)	→	Above average	Average
• Migration:			
- Immigration	n/a ^(c)	Above average	n/a
- Out-migration	n/a	Above average	n/a
Innovation Indicators			
• R&D expenditures (as a % of total GDP)	→	Below average	Below average
Business Enablers			
• Tax rates:			
- Corporate	→	Less favourable	Less favourable
- Personal (overall)	→	Average	Less favourable

Headline Indicators	BC Trends ^(a)	Comparison ^(b) to	
		Provinces	US States
Result Indicators			
• High tech GDP (as a % of total GDP)	↑	Below average	n/a
• Employment	↑	Below average	Below average
• Wages earned	↑	Average	Below average
• Skills needs/ vacancy rates	→	Average	n/a

Notes: ^(a)Comparisons to Provinces and US States are for the latest year(s) for which data were available.

^(b)Trends: Generally Upwards: ↑; Little or no significant change: →; Generally Downwards: ↓

^(c)n/a: Trends or comparisons were not available.

Overall, recent BC high tech indicators have risen numerically in the areas of Resources and Results, but have been flat in the areas of Innovation and Business Enablers. Compared to other jurisdictions, most BC indicators are average or below average, and BC is not a leader in any area.

2. Detail Indicators

Benchmark data have also been gathered for 30 detail indicators of interest to particular groups.

As illustrated in Exhibit IV-3, detail indicators trends have generally been positive. However, some relatively important areas have shown negative trends, such as new business incorporations, and productivity gains.

Comparison with other jurisdictions should be interpreted with caution, as data were not available for all jurisdictions, and in some cases comparisons with only one other jurisdiction were available.

Exhibit IV-3 Detail Indicators

Detail Indicators		BC Trends (where available)	Comparisons (where available)
Resource Indicators	Education levels	n/a	Average
	Post secondary enrollment	↑	n/a
	Co-op student placements	↑	n/a
	8th and 12th-grade math and science assessments	n/a	Average
	Foreign direct investment	n/a	Below average
	Telecommunications infrastructure (per capita)	n/a	Above average
	Internet connectivity	↑	Above average

	Detail Indicators	BC Trends (where available)	Comparisons (where available)
Innovation Indicators	R&D personnel	n/a	Average
	Federal research laboratories	→	n/a
	R&D intensity	↑	Average
	Joint university/industry R&D	→	Above average
	Patents and inventions	↑	Average
	Scientific publications	↓	n/a
	Funding for technology transfer centres	↑	n/a
	University research commercialized	↑	Below average
	New business incorporations and survival	↓	n/a
	Venture capital	↑	Average
	Initial public offerings	↑	n/a
	Market value of public high tech firms	↑	n/a
Business Enablers	Business costs	n/a	Average
	R&D tax credits	n/a	Above average
	Cost of R&D	↓	Below average
	Other incentive and support programs	↑	n/a
Result Indicators	Earnings distribution	↑	n/a
	Incentive compensation	↑	n/a
	Employee turnover	n/a	n/a
	Productivity gains	↓	
	Revenues & profitability	↑	n/a
	High tech trade (exports/imports)	↑	n/a
	Technology diffusion & adoption	n/a	Below average

C. Summary

This study clearly illustrates the paradox of BC's high tech sector. Looking within the Province, this sector's growth in recent years has been very strong, in terms of all economic indicators. On the other hand, many of BC's "current state" indicators are still behind those of the benchmark jurisdictions — Alberta, Ontario, Quebec, Washington State, Oregon and Massachusetts — examined in this report.

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Appendix A

Data Sources & References

Appendix A

Data Sources & References

All indicators were developed from existing secondary sources. In most cases, indicators from secondary sources required the reconfiguration of existing datasets. These groupings of data were derived from a wide range of sources; therefore, there are some unavoidable variations in the time frames used and in the specific variables that define the indicators being measured. Throughout the document dollar values are presented in current Canadian dollars unless noted.

Following are additional notes on data sources for some specific indicators.

1. Science & Engineering Graduates

Canada data are from BC Stats; The University Presidents' Council database (www.inst.uvic.ca/tupc/tud_tables); and BC Institute of Technology: *Facts and Figures* (www.bcit.ca/~irp/facts/bcitfact.htm).

US data are from National Center for Education Statistics 1999 (<http://www.nces.ed.gov/pubs2000>).

2. Migration

Data are from Industry Canada (Statistics Canada Cat. 81-003); The Laurier Institution: *Skills Flows of High Technology Workers Into and Out of British Columbia* (www.laurierinst.com/Skillsflow/); and The University Presidents' Council: *Class of '96 One-Year after Graduation* (www.tupc.bc.ca/graduate_outcomes)

3. Research & Development

Data for Canada are from Statistics Canada. For the US, data are from the National Science Foundation (NSF): *Science & Engineering Indicators 2000* (www.nsf.gov/sbe/srs/), *Science and Engineering Profiles by State* (www.nsf.gov/sbe/srs/nsf00329/overview.htm), and NSF WebCaspar Database (www.nsf.gov/sbe/srs/)

4. Education Spending

Data for Canada are from Statistics Canada; and the Council of Ministers of Education: *Education Indicators in Canada 1999* (www.cmec.ca)

Data for the US are from the US National Center for Education Statistics (<http://nces.ed.gov/pubs2000/digest99/listoftables.html#top>)

5. Tax Rates

Data for personal tax rates are from BC Stats provided by the BC Ministry of Finance and Corporate Relations, BC Budget 2000; and from KPMG.

Data for corporate tax rates are from BC Stats; and Statistics Canada: *Measuring the Attractiveness of R&D Tax Incentives: Canada and Major Industrial Countries 1999*

6. Gross Domestic Product

Data for Canada are from BC Stats; for the US from the Bureau of Economic Analysis (www.bea.doc.gov.bea/regional/gsp).

7. Employment

Data for Canada are from BC Stats.

Data for the US are:

- Washington State: from Washington State Employment Security Department: Labour Market Information (www.wa.gov/esd/lmea/download/download.htm).
- Oregon: Oregon: from Oregon Employment Department: Labour Market Information System (www.olmis.org/olmisj/OlmisZine)
- Massachusetts: from Massachusetts Division of Employment and Training (www.detma.org/lmi/lmi.htm)

8. Wages

Data for Canada are from BC Stats; for the US, from the American Electronics Association (AEA) *Cyberstates Report* (www.aeanet.org/aeanel/public/research/index.html)

9. Skills Needs/Vacancy Rates

Data are from BC Stats; BC Technology Industries Association ReportCard (www.bctia.org/resources/industry.html); *The Alberta Technology Report March 2000* (www.altatechreport.com/); Industry Canada: *Results of the Survey on Human Resource Issues in the Information Technology Industry 1998*

10. Education Levels of High Tech Sector Workforce

Data are from BCTIA ReportCard; and Industry Canada: *Canada's Regions and the Knowledge-Based Economy*

11. Post-Secondary Enrollment in High Tech Disciplines

Data are from The University Presidents' Council database (www.inst.uvic.ca/tupc/tud_tables); and BC Institute of Technology: *Facts and Figures* (www.bcit.ca/~irp/facts/bcitfact.htm)

12. Foreign Direct Investments

Data are from Statistics Canada: *Issues in Provincializing Foreign Direct Investment*

13. Telecommunications Infrastructure

Data are from Statistics Canada: *1998 Annual Survey of Telecommunications Providers*

14. Internet Connectivity

Data are from Western Diversification Canada: *The new Frontier: Enterprise and E-Business in Western Canada (2000)* (www.wd.ca/eng/ecommerce) and AC Nielsen: *Internet Planner 2000*

15. Joint Research & Development

Data for Canada are from Statistics Canada; UBC & SFU University/Industry Liaison Offices (www.uilo.ubc.ca) and (www.sfu.ca/uilo); for the US from the National Science Foundation: *Science & Engineering Indicators 2000*;

16. Patents & Inventions

Data are from BC Stats; Statistics Canada; UBC & SFU University/Industry Liaison Offices (www.uilo.ubc.ca) and (www.sfu.ca/uilo); Association of University Technology Managers: *AUTM Licensing Survey: FY 1998*

The AUTM survey includes major research universities in Canada and the US.

17. University Research Commercialized

Data are from UBC & SFU University/Industry Liaison Offices (www.uilo.ubc.ca) and (www.sfu.ca/uilo); Association of University Technology Managers: *AUTM Licensing Survey: FY 1998*

18. Cost of R&D

Data are from Statistics Canada: *Measuring the Attractiveness of R&D Tax Incentives: Canada and Major Industrial Countries*

19. Technology Diffusion & Adoption

Data are from Statistics Canada: *Survey of Advanced Technology in Canadian Manufacturing 1998*; and Forrester Research Inc.: *Mapping Canada's Technology Zones*".

Appendix B

Approach and Methodology

Appendix B

Approach and Methodology

The performance measurement system framework and indicators were developed through a multi-step process.

A. Jurisdictional research

Two papers developed by the Science Council under the PMC's leadership were used as a springboard for this study:

- The first report "Definitions and Models of High Technology Industry and Innovation Economy: A Comparative Review" presents a comparative review (BC, Alberta, Manitoba, Ontario, Quebec, Massachusetts, Washington and Oregon) of what industries are classified as high technology and of concepts of innovation economy in selected jurisdictions.
- The second paper "A Model of the BC High Technology Sector: Description of Factors and Linkages Affecting Growth of the High Technology Sector in the Context of an Innovation Economy" is a composite presentation of critical elements of an innovation economy and how they are applied to the analysis of performance of the high tech sector, and lists a collection of indicators currently used in various jurisdictions to measure these critical elements.

KPMG reviewed PMC's documentation and conducted additional research, including:

- Jurisdictions suggested by the Performance Measures Committee (PMC) as potential benchmarks: Alberta, Ontario, Quebec, Washington, Oregon, Massachusetts, and Texas.
- Other US and international jurisdictions: Texas Healthcare Technology Industry, "New Economy Index", the American Electronics Association Index, New Zealand's "High Technology Competitiveness in Manufacturing Production and Trade" and "Baseline Indicators for Measuring Progress towards the Goals of Science and Technology 2010", and Ireland's "Annual Competitiveness Report".

From this review an initial list of proposed indicators was developed, incorporating the list from the PMC and adding other indicators found to be common in several surveyed jurisdictions.

B. Survey of representatives from industry, government and academia

To solicit feedback and guidance on the appropriateness and relevance of the preliminary list of performance indicators, a survey instrument was developed, using a numeric scoring system.

A total of 19 interviews were conducted, involving seven of the 10 PMC members and 12 external representatives of the high technology sector. Overall, eight industry representatives, two academics and nine government representatives were interviewed. Interviewees were asked to comment on the relevance of each of the preliminary performance indicators, their appropriateness as "headline" or "detail" indicators for BC, and any unique issues or performance aspects attributable to one or more of the sub-sectors. The profile of interviewees by sector and by type of organization is shown in Exhibit A-1.

Exhibit B-1
Profile of interview subjects

	High Tech General	Info Tech	Biotech.	Fuel Cells	New Media	Aerospace
Industry	1	2	2		2	1
Education	2					
Government	7			1		1

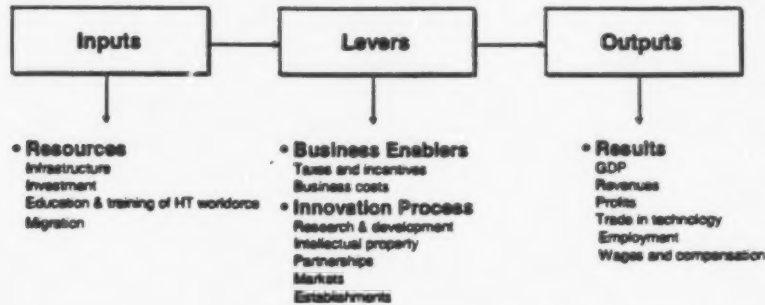
C. Performance measurement framework

The framework provided by the PMC was used to develop performance indicators and to guide readers in comprehending the significance of the results.

The framework, as illustrated in Exhibit B-2, was adapted from the Massachusetts Innovation Index. It is based on a concept that links resources to economic results through innovation and business levers, organizing the indicators of performance into four interrelated and interactive measures:

- **Resources:** public and private inputs. These indicators measure the critical inputs that the high tech sector needs to improve and sustain its competitive advantage.
- **Innovation:** interactions that translate resources into results. These indicators are technical, scientific, commercial and/or financial resources that help generate knowledge and ideas, and support a technology-based industry.
- **Business enablers:** business conditions that influence interactions. These are indicators of the business climate in which innovative ideas and technology-based products are being promoted and developed.
- **Results:** outcomes for people and business. Results measure the impact of the high tech sector in terms of benefits to business and people, and the overall effect on economy and society.

Exhibit B-2 Framework for interpreting indicator data



This framework provided for a broader interpretation of the indicators, beyond an assessment of achievement toward the BC High Technology Strategy objectives. It also allowed for a cross-mapping of the broader outlook to the strategy, giving the reader two alternate perspectives on the meaningfulness of the data.

D. Indicators selection process and criteria

1. Headline Indicators

For headline indicators the total number of interview subjects, who perceived an indicator to be a headline indicator, were recorded. This number was divided among those who perceived the indicator to be a "definite" headline and those who perceived it to be a "possible" headline.

The criteria developed by the PMC for headline, and used by KPMG included:

- Ability of the public to grasp
- Ability to compare BC's performance with other jurisdictions
- Ability to compare high tech performance with other sectors in BC
- Quantitative recommendations made by interview subjects
- Importance rating ascribed by sub-sector interview subjects
- Ease of measurement (in BC)
- Reliability/accuracy of data
- Ability to perform trend analysis over time

Taking into consideration scores received and headline criteria, the following indicators were recommended as headline indicators:

- Science and Engineering graduates
- R&D expenditures
- Education spending
- Tax rates

- High tech contribution to GDP
- Employment
- Skills needs
- Wages earned
- Migration

2. Detail indicators

Detail indicators were selected on the basis of two sets of interview results. For the high technology sector in general, interview results were analysed from a quantitative perspective, using the scoring system from the survey. The scores were recorded and analyzed to derive an average for each data set within each indicator.

For the sub-sectors, representatives were asked to discuss each indicator in the context of their industry, and to indicate whether it was particularly relevant or not relevant for addressing concerns and tracking success. They also were asked to explain the significance, or lack thereof, for the high tech industry in general.

Then both interview result sets were analysed, and based on the score and/or relevance to a specific subsector, recommendations were made on the preliminary selection of detail indicators. The long preliminary list of indicators was distilled down to 45 recommended indicators.

Once the 45 indicators were identified, recommended indicators and datasets were ranked on the basis of score received and potential difficulty of obtaining reliable data. At that time, the PMC reviewed the recommendations and made the final selection of nine headline and 30 detail indicators.

E. Selection of benchmark jurisdictions and industry sectors

1. Benchmark jurisdictions

The following jurisdictions were recommended as benchmarks:

- Canada: Alberta, Ontario, Quebec.
- US: Washington, Oregon, Massachusetts.

Alberta, Ontario, Quebec, Washington and Oregon were recommended for inclusion based on the following criteria:

- Direct competition with BC for high tech business.
- Economic conditions relatively comparable.
- Data available for headline indicators.

In addition, Massachusetts was recommended for inclusion, as Massachusetts has a well-developed "innovation index" that provides a valuable benchmark methodology.

2. Comparing to other BC's sectors

One aspect of the report is to compare the high tech sector to other BC industry sectors. Two criteria were used in proposing comparative industry sectors:

- Importance to the BC economy (contribution to GDP).
- High growth.

The recommended industry sectors are forestry, tourism, finance/insurance & real estate (FIRE), and film.

Indicators recommended for sector comparisons are key results indicators, such as GDP and employment.

F. List of indicators

As indicated earlier, the indicators were grouped into four major components which measure resources, innovation, business enablers, and results. The indicators have also been cross-mapped to measure BC's performance against the BC's High Tech Strategy goals.

Exhibit B-3 lists the indicators and shows how the indicators fit within the selected framework, and link to the High Tech Strategy performance goals.

Exhibit B-3
High tech performance measurement system

	Headline Indicators	BC High Tech Strategy goals ⁽¹⁾	Detail Indicators	BC High Tech Strategy goals ⁽¹⁾
Resource Indicators	Science & engineering graduates	2	Education levels	2
	Education spending	3	Post secondary enrollment in high tech disciplines	2
	Migration	2,4	Co-op student placements	2
			Eight & 12th-grade math and science assessments	2
			Foreign direct investment	1,4
			Telecommunications infrastructure	1
			Internet connectivity	1

	Headline Indicators	BC High Tech Strategy goals ⁽¹⁾	Detail Indicators	BC High Tech Strategy goals ⁽¹⁾
Innovation Indicators	Research & development (R&D)	3	R&D personnel	3
			Federal research laboratories	3
			R&D intensity	3
			Joint University/Industry R&D	3
			Patents and inventions	3
			Scientific publications	3
			Funding for technology transfer centres	3
			University research commercialized	3
			New business incorporations and survival	1,4
			Venture capital	1,3,4
			Initial public offerings	1,4
			Market value of public high tech firms	1
Business Enablers	Tax rates	1	Business costs	1
			R&D tax credits	1,3
			Cost of R&D	1,3
			Other provincial incentive and support programs	1,3
Result Indicators	GDP	1	Earnings distribution	1,2
	Employment	1	Incentive compensation	2
	Wages earned	1,2	Employee turnover	2
	Skills needs/ vacancy rates	2,4	Productivity gains	1
			Revenues & profitability	1
			High tech trade (imports, export markets)	1,3, 4
			Technology diffusion & adoption	1,3

⁽¹⁾ Relevance to the BC High Tech Strategy goals:

5. Make BC a place of choice
6. Develop and attract talent
7. Expand research and development
8. Market BC

G. Study scope and methodology

The focus for data collection and analysis is defined by the framework which is organized into headline and detail indicators.

Exhibit B-4 illustrates the scope of data collection in terms of headline indicators, detail indicators, and benchmark jurisdictions. In this first effort to illustrate trends in innovation and technology, data for up to three years have been included, where available.

Exhibit B-4 (a)
Scope of Data Collection – Headline

		Comparative Data		
		Trends	Provinces	US States
HEADLINE				
Resource Indicators:				
• Science & engineering graduates (per capita)		yes	yes	yes
• Migration:	Immigration	no	yes	n/a
	Out-migration	no	yes	n/a
Innovation Indicators				
• R&D expenditures (as a % of total GDP)		yes	yes	yes
• Education spending:	Primary/secondary	yes	yes	yes
	Post-secondary	yes	yes	yes
Business Enablers				
• Tax rates:	Corporate	yes	yes	yes
	Personal	yes	yes	yes
Result Indicators				
• High tech GDP (as a % of total GDP)		yes	yes	no
• Employment		yes	yes	yes
• Wages earned		yes	yes	yes
• Skills needs/ vacancy rates		yes	yes	no

Exhibit B-4 (b)
Scope of Data Collection – Detail

	Trends	Comparative Data Provinces
Resources Indicators		
• Education levels	no	yes
• Post secondary enrollment	yes	no
• Co-op student placements	yes	no
• 8th and 12th-grade math and science assessment	no	yes
• Foreign direct investment	no	yes
• Initial public offerings	yes	no
• Telecommunications infrastructure	no	yes
• Internet connectivity	yes	yes

	Trends	Comparative Data Provinces
Innovation Indicators		
• R&D personnel	no	yes
• Federal research laboratories	yes	no
• R&D intensity	yes	yes
• Joint university/industry R&D	yes	no
• Patents and copyrights	yes	yes
• Scientific publications	yes	no
• Funding for technology transfer centres	yes	no
• University research commercialized	yes	yes
• New business incorporations and survival	yes	no
• Venture capital	yes	yes
• Market value of public high tech firms	yes	no
Business Enablers		
• Business costs	yes	yes
• R&D tax credits	no	yes
• Cost of R&D	yes	yes
• Other incentive and support programs	yes	no
Result Indicators		
• Earnings distribution	yes	no
• Employee turnover	no	no
• Employee benefits	yes	no
• Productivity gains	yes	no
• Revenues & profitability	yes	no
• High tech trade (exports/imports)	yes	no
• Technology diffusion & adoption	no	yes

H. Data selection criteria and analysis

Readers should note that charts and text in this publication only deal with the highlights of the information that has been collected. In collecting datasets and deciding whether and how to use them in this report, a number of criteria have been considered, including:

- Relevance to the subject of the headline/detail indicator. Some available datasets may have been excluded from this report if they were less meaningful to the indicators.
- Comparability of data collection method to the data collection method in BC. It was not always possible to get meaningful comparisons with data collected from different sources. In such cases, only information that could be compared was included in this report.
- Reliability of data and data sources. Some available data may have been excluded from this report, if other data were more appropriate for the specific indicators, or originated from more reliable sources.

- Availability of comparable data over a period of three years. It was attempted, as much as possible, to use data which could be updated in future years.

The reader is cautioned that the information contained in this document is drawn from hundreds of primary and secondary data sources, and that many of inter-jurisdictional and inter-sectoral comparisons can be expected to have issues relating to the consistency of measurement approaches among jurisdictions and sectors. The reader is strongly advised to check the primary source in drawing conclusions. (See References on the charts and in Appendix A – Sources and References.)

I. Defining innovation and the high technology sector

The Conference Board of Canada defines innovation as “a process through which economic value is extracted from knowledge through the generation, development and implementation of ideas to produce new or improved products, processes and services”. Defining innovation as a process of extracting economic value from knowledge implies that “business” is the critical player in this process. “Business” or the high technology sector is the engine of the innovation economy.

This study has adopted the definition used by BC Stats in its “Profile of the British Columbia High Technology Sector” and the “British Columbia High Technology Sector Input Indicators Report”. This definition includes industries that stress research and development, that employ in a high proportion scientists and technicians, or that produce or use technologically sophisticated products.

Exhibit B-5 lists the industries which are defined, for the purpose of the present report, to constitute the high-technology sector in British Columbia. Where the weight column shows 100, 100% of the industry is included in the high technology sector. In those cases where numbers are given, only the indicated percentage of the industry meets the definition of high technology.

Exhibit B-5
Industries in the High Technology Sector as defined by BC Stats

SIC ¹⁴	Industry	Sector	Weight %
772	Computer and Related Services	Services	100
868	Health and Other Medical laboratories	Services	100
3192	Construction, Mining Machinery and Materials Handling	Manufacturing	13
3194	Turbine and Mechanical Power Transmission Equipment	Manufacturing	6
3199	Other Machinery and Equipment Industries NEC	Manufacturing	3
3211	Aircraft & Aircraft Parts Industry	Manufacturing	100
3271	Shipbuilding and Repair Industry	Manufacturing	11
3351	Telecommunications Equipment Industry	Manufacturing	100
3352	Electronic Parts and Components	Manufacturing	100
3359	Other Communication and Electronic Equipment	Manufacturing	100
3361	Electronic Computing and Peripheral Equipment	Manufacturing	100
3362	Electronic office, Store and Business Machines	Manufacturing	100

SIC ¹⁴	Industry	Sector	Weight %
3369	Other Office, Stores and Business Machines	Manufacturing	100
3372	Electrical Switchgear and Protective Equipment	Manufacturing	100
3379	Other Electrical Industrial Equipment Industries	Manufacturing	100
3381	Communications and Energy Wire and Cable Industry	Manufacturing	41
3711	Industrial Inorganic Chemical Industries NEC	Manufacturing	10
3741	Pharmaceutical and Medicine Industries	Manufacturing	100
3911	Indicating, Recording and Controlling Instruments	Manufacturing	100
3912	Other Instruments and Related Products	Manufacturing	100
3994	Musical Instrument and Sound Recording	Manufacturing	11
3999	Other Manufactured Products Industries	Manufacturing	6
772	Computer and Related Services	Services	100
868	Health and Other Medical laboratories	Services	100
7752	Offices of Engineers	Services	100
7759	Other Scientific and Technical Services	Services	100

More information on this definition and the weighting is available in the 1995 paper "Defining the High Technology / Knowledge Sector in British Columbia" published by BC Stats¹⁵.

Data obtained from sources other than BC Stats, may be based on different definitions of the high tech sector, and jurisdictional comparisons should be made with care.

J. Defining the US high technology sector

For US States, the following industries were included in our calculations for employment in the high tech sector. These industries were selected as they are the closest match to the BC Stats definition used in this report. Where the weight column shows 100, 100% of the industry is included in the high technology sector. In those cases where numbers are given, only the indicated percentage of the industry meets the definition of high technology. Exhibit B-6 lists the industries included to define high tech employment in the US.

Exhibit B-6

US Industries Included for US high tech employment

US SIC	Industry	Weight %	US SIC	Industry	Weight %
2819	Industrial inorganic chemicals	10	3827	Optical instruments & lenses	100
2833	Medicinal & botanical preparations	100	3829	Measuring & controlling devices, nec	100
2834	Pharmaceutical preparations	100	3841	Surgical & medical instruments	100
2835	Diagnostic substances	100	3842	Surgical appliances & supplies	100
3354	Aluminium extruded products	10	3843	Dental equipment & supplies	100
3357	Nonferrous wire drawing & insulation	10	3845	Electromedical equipment	100
3511	Turbines & turbines generator sets	6	4812	Radiotelephone communications	100
3571	Electronic computers	100	4813	Telephone communications, ex radio	100
3577	Computer peripheral equipment	100	4822	Telegraph & other communications	100

US SIC	Industry	Weight %	US SIC	Industry	Weight %
3579	Office machines	100	4899	Communications services, nec ¹⁶	100
3613	Switchgear & switchboard apparatus	100	5045	Wholesale computers, peripherals & software	100
3651	Household audio and video equipment	100	5065	Wholesale electronic parts & equipment	100
3661	Telephone & telegraph apparatus	100	7371	Computer programming services	100
3663	Radio & TV communications equipment	100	7372	Prepackaged software	100
3669	Communications equipment	100	7373	Computer integrated systems design	100
3672	Printed circuit boards	100	7374	Data processing & preparation	100
3674	Semiconductors & related services	100	7375	Information retrieval services	100
3677	Electronic coils & transformers	100	7376	Computer facilities management	100
3679	Electronic components, nec	100	7377	Computer rental & leasing	100
3721	Aircraft	100	7378	Computer maintenance & repair	100
3728	Aircraft parts & equipment	100	7379	Computer related services, nec	100
3731	Ship building & repairing	10	8711	Engineering services	100
3732	Boat building & repairing	10	8713	Surveying services	100
3812	Search & navigation equipment	100	8731	Commercial physical research	100
3821	Laboratory apparatus & furniture	100	8732	Commercial nonphysical research	100
3823	Process control instruments	100	8733	Non-commercial research organizations	100
3825	Instruments to measure electricity	100	8734	Testing laboratories	100
3826	Analytical instruments	100			

For US wages, data come from the American Electronic Association (AEA) Cyberstate reports. AEA includes in its definition of high-tech sector the industries listed in Exhibit B-7 below. All industries are weighted at 100%.

Exhibit B-7

US Industries included for US high tech wages (AEA)

US SIC	Industry	US SIC	Industry
3571	Electronic computers	3826	Analytical instruments
3572	Computer storage device	3827	Optical instruments & lenses
3575	Computer terminals	3829	Measuring & controlling devices, nec
3577	Computer peripheral equipment	3844	X-Ray apparatus
	Calculating and accounting machines, except	3845	Electromedical equipment
3578	electronic computers	3861	Photographic equipment & supplies
3579	Office machines	4812	Radiotelephone communications
3651	Household audio and video equipment	4813	Telephone communications, ex radio
	Phonograph records and pre-recorded audio	4822	Telegraph & other communications
3652	tapes & CDs	4841	Cable & other pay TV services
3661	Telephone & telegraph apparatus	4899	Communications services, nec ¹⁷
3663	Radio & TV communications equipment	7371	Computer programming services
3669	Communications equipment		
3671	Electron tubes		

US SIC	Industry	US SIC	Industry
3672	Printed circuit boards	7372	Prepackaged software
3674	Semiconductors & related services	7373	Computer integrated systems design
3675	Electronic capacitors	7374	Data processing & preparation
3676	Electronic resistors	7375	Information retrieval services
3678	Electronic connectors	7376	Computer facilities management
3679	Electronic components, nec	7377	Computer rental & leasing
3721	Aircraft	7378	Computer maintenance & repair
3728	Aircraft parts & equipment	7379	Computer related services, nec
3812	Search & navigation equipment	8731	Commercial physical research
3821	Laboratory apparatus & furniture	8732	Commercial nonphysical research
	Automatic controls for regulating residential		
3822	& commercial appliances	8733	Non-commercial research organizations
3823	Process control instruments	8734	Testing laboratories
3824	Totalizing fluid meters and counting devices		
3825	Instruments to measure electricity		

K. Recommendations for subsequent performance measurement studies

This report represents the initial benchmark study of BC high tech sector's performance. For subsequent performance measurement studies it is recommended that:

- Where meaningful and comparable data for most jurisdictions are not available, consideration be given to reclassifying headline indicators as detail indicators. For instance, for this study, meaningful comparable data for indicators such as Skills Needs/Vacancy Rates and Migration were difficult to obtain for all jurisdictions, as there are no reliable secondary source which collects this type of information on a province/state basis.
- A "creativity" indicator (e.g. Patents) be considered for addition as an Innovation headline indicator; and that an indicator such as Venture Capital or IPOs be also considered for Innovation headline, since comparable data are readily available.
- In the event that the Science Council and BCTIA perform related studies in the future, that these studies be performed collaboratively, to enhance the comparability and usefulness of the results.
- Consideration be given to combining datasets into composite indices, when technology is changing quickly and the relevance and usefulness of individual datasets may also change rapidly.

Appendix C

Acknowledgement

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* * *

The reader is cautioned that the information contained in the "State of the High Technology Sector in British Columbia: Inaugural Benchmark Report" is drawn from hundreds of primary and secondary research data sources, and that many of inter-jurisdictional and inter-sectoral comparisons can be expected to have issues relating to the consistency of measurement approaches among jurisdictions and sectors.

In interpreting and further analyzing the specific charts and tables contained in this report, the reader is strongly encouraged to also review the primary sources from which they are drawn, and to perform an independent assessment of the comparability issues regarding specific datasets.

KPMG will not be responsible for any decisions undertaken by other parties based on the contents of this report.